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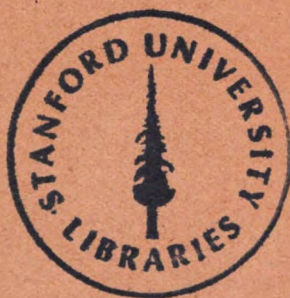


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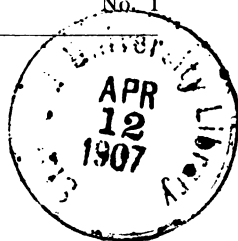
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On Some Ground-Dwelling Arachnida.*

By F. C. Luck, B. A., (Cantab.), F. R. M. S., Whittier, Cal.

Introduction. There are 5 orders of the class Arachnida which, owing to their nocturnal habits, and the consequent difficulty and inconvenience attending their study, have not received that general attention which they deserve. These interesting groups are: The Mygalomorpha, or large tubedwelling spiders; the Scorpions; the Uropygi, or whip-scorpions; the Solifugæ, or scorpion-spiders; and lastly the Amblypygi, which are comparatively rare, and have no popular name, though their extraordinary appearance, something between a spider and a bad dream, would make it an easy task to endow them with an appropriate title.

I studied these groups during a residence of eleven years in the East Indies, and subsequently had the advantage of working on the available material at the British Museum, under the guidance of Mr. Pocock, the European authority on the Arachnida. So, on arriving in Southern California, I naturally wished to study those representatives of the above-named orders peculiar to the Pacific Coast. Thanks to the courtesy of Mr. Lummis and of the staff of the Research department of the Public Library, I was put in touch with the national sources of information; only to discover that whilst Dr. McCook and Professor and Mrs. Peckham have dealt exhaustively with the American spinning-spiders, little has been published relating to the ground-dwelling Arachnida. True, I unearthed a paper by Mr. Nathan Banks, in which he names one species each of 2 genera of Solifugæ, and 3 out of the 4 genera of scorpions so far established in California. Of the others, no mention is made; and as the paper was evidently intended solely to identify material sent for that purpose, no description was appended which would enable the student to recognize such specimens as he might find.

It follows, therefore, that an open field is left for systematic work on these groups; and so I thought that a short epitome of their morphology and physiology might prove of interest to this society. It will, I hope, be found to be both accurate and intelligible, though neither too superficial nor needlessly technical. This paper is partly the result of a personal study of the Arachnida of other lands, partly an epitome of other workers' researches; and I offer it as merely a preliminary to detailed work on the Arachnida of Southern California.

*Read before the Biological Section of The Southern California Academy of Sciences, Feb. 18, 1907.

Morphology. The Arachnida are not insects, though often incorrectly spoken of as such; but may be defined as arthropodous (jointed) animals, in which the body is never composed of more than 18 somites or segments, and is divisible into 2 main regions—an anterior or cephalo-thorax, and a posterior or abdomen. The class comes between the Crustacæ and Hexarthra or insects, being distinguished from each by marked structural differences, yet having strong affinities to both.

The chief external differences between it and the Crustacæ are: the absence of a specialized auditory organ, the simplification of the mouth-parts, the modification of the gills into lung-sacs, and simple instead of compound eyes; whilst the swimming-telson of the lobster (for instance) becomes either a weapon, a harmless whip-tail, or is entirely absent.

The Arachnida may be distinguished from the true insects by the division of the body into two instead of into three main regions; by the presence of 8 instead of 6 legs, and the absence of antennæ. The eyes are simple instead of compound, there are no wings; and in most genera lung-sacs take the place of the tracheæ of the insect.

In this paper I omit the remaining orders of Arachnida, namely: the false or book-scorpions, the Opiliones or harvesters, and the Acari or ticks; nor do I deal with the orb-weaving spiders.

In the Arachnida we have a type of marked persistence of life, for there are but slight differences between fossil and recent Arachnida; and, since no advance in organization is indicated, persistence of habit may be inferred. These animals undergo no biogenetic changes, such as the larval and pupa stages of the insect. On the contrary, the individual is born in substantially the same form as that which characterizes its adult life; it merely increases in size by a series of moults. From this we infer that ages ago the Arachnida evolved those specific forms best ensuring survival; though naturally sufficient time has elapsed for them to have become specialized into many diverse forms.

The remote ancestor of the class was possibly one of the Chætopoda, or bristle-footed worms; and the archetype may have been a creature, of which the nearest recent representative is that curious and lonely survival, the *Peripatus*, which is neither worm nor insect; and over whose classification a war has been waged among zoologists as bitter as the historic strife in microscopical circles, over the relation which the numerical aperture of the condenser should bear to that of the objective.

If by means of diagrams we represent the archetype of the Arachnida, and the specialized generic forms evolved there-

from, it will be easier to trace the connection existing between them, and the relation which they bear to the primal form and to each other.

Fig. 1. Represents the archetype—according to Messrs. Thorell and Pocock—an Arthropod with a body consisting of 18 somites; the anterior 6 of which are provided with large appendages for locomotion and grasping; having a cluster of median eyes, and a group of lateral eyes on each side. In recent Arachnida, the number of eyes varies from 2 to 8, differently disposed in the various genera. One species of whip-scorpion is eyeless; and a spider is found in the Mammoth cave in Kentucky, in which the eyes are completely atrophied. The head and thorax of the archetype are fused together. Each of the 6 succeeding somites bears a pair of small ventral appendages; these have become lost by the 6 posterior somites.

Now, it is obvious that this body was very unwieldy, and consequently ill-suited to the needs of a predaceous animal. By means of the succeeding diagrams it may be shown in detail how each order of the Arachnida have departed from and improved this useless body, so as to best suit the individual conditions of existence. And it will be of advantage to bear in mind that Evolution is as much a process of elimination, as of elaboration and addition.

Fig. 2. The Scorpions approach most closely to the original form; and in them the 5 unwieldy posterior somites become narrowed into the so-called "tail" (really a part of the abdomen), having at its end a post-anal sclerite or sting. The 4 posterior appendages of the 6 abdominal somites become merged into the stigmata of the lung-sacs; the second pair are modified into those curious organs of perception, the pectines or combs, which are peculiar to this group.

Fig. 3. In the Whip-tails (Uropygi), the whole abdomen is greatly reduced in length, and the 3 posterior somites are narrowed to support the multi-articulated, harmless telson or whip, corresponding to the "sting" of the scorpion and the swimming-plates of the lobster. A deep constriction separates the cephalothorax from the abdomen, and two of the lung-sacs disappear.

Fig. 4. In the Phrynichidæ (Amblypygi), the whole body is shortened into a kidney shape; the "tail" entirely disappears; and the scorpion's pincers are transformed into a pair of terrible grappling-hooks. The first pair of legs become very long and antenniform; and are no longer used as walking-legs, but as tactile organs, like the antennæ of insects. „ „ „

Fig. 5. In the Araneæ or true spiders, there is a deep constriction in the shape of a stalk or pedicel between the cephalo-

thorax and the abdomen; the pincers of the scorpion are modified into a pair of tactile palps; whilst the small mouth-pincers are elaborated into double-jointed fangs, having a poison-sac situated in the basal portion. The segmentation of the abdomen disappears in most genera, and the organ becomes soft. The abdominal appendages disappear, with the exception of the 2 last pairs, which, in this order only, become spinning mamillæ. Some spiders, like scorpions, breathe by means of lung-sacs, the higher forms by tracheal tubes.

Fig. 6. In the Solifugæ, or scorpion-spiders, the cephalothorax is divided into 3 somites; the abdomen approximates to the spider shape, and the telson is lost. The pincers become gripping-jaws, having their axes in a vertical instead of a horizontal plane.

Distribution. We come next to the distribution of the Arachnida. The Spiders are cosmopolitan, to as far north as Greenland and Spitzbergen.

The Scorpions are found in both hemispheres, between lines represented, roughly, by the 45th parallel of north latitude and the 47th parallel of south latitude.

The Whip-tails are found in the south of North America, Central and South America, in India, China, and Polynesia.

The Phrynichidæ occur in the same area of this continent as the preceding order, plus Patagonia; in Africa, India, China, and Polynesia. As might be expected from the topsy-turvy geology of Australasia, its scorpions differ greatly from those of the other regions, and are entirely absent from New Zealand. This absence, in view of the fact that they are found in all the other islands of the Polynesian archipelago, is one of the, as yet, unsolved problems of arachnology. Neither the whip-tails nor the Phrynichidæ are found in Australasia.

In North America, the northern limit of scorpions seems to be between the 35th and 40th parallels, on a line approximately bisecting this state and Virginia on the Atlantic coast. To this region has been given, for the purposes of taxonomy, the name of the Sonoran province of Merriam. In California, 4 genera have so far been established; namely—*Uroctonus*, *Hadrus*, *Vejois* and *Centrurus*. The whip-tails and Phrynichidæ have been found as far north as Lower California; and I am hopeful they may be found in favorable, that is, desert and sandy localities in Southern California. Of the Solifugæ, Mr. Banks names 2 genera as found in California, one of which together with 2 genera of scorpions, I have found at Whittier.

Physiology. We come now to the physiology of these Arachnida. As with all other animals, their life-activities are directed to 3 main ends: nutrition or offense, defense, and re-

production. To each of these aspects, in the order named, I invite your attention.

A glance at any of the Arachnida shows that they are as well equipped for a predatory career as a political "boss." The pincers and sting of the scorpion, the grappling-hooks of the Phrynichidæ, the jaws and pincers of the whip-tails and the scorpion-spiders, and the poison-fangs of the spider all serve the same end, namely, the securing of the various kinds of live food on which the different orders feed.

The sting and fangs of the scorpion and spider respectively are needed to enable them to secure such relatively powerful victims as cockroaches and large flies. The poison secreted seems to partake of the properties of snake-venom rather than those of insect poison. It does not appear to irritate the tissues, as, for example, does the sting of a bee; but, like the venom-peptone and venom-globulin of the snake, acts rather on the motor-centres through the circulation. And the cause of this difference may be found, if we consider the end in view in each case. The bee's sting is only needed to secure immunity from molestation, and to effect this purpose it need not be fatal; it suffices that irritation in greater or less degree should be caused. But the scorpion and spider need to secure a meal; therefore their poison must be able to at least paralyze their prey. It is interesting to watch the swift dart of the large Indian scorpion, *Palamnaus*, on a cockroach. It catches the insect in its powerful pincers, leisurely (at least, such is the impression given) feels about with the sting till the right spot—usually the upper part of the thorax—is found, when the sting is firmly pressed, rather than struck, home; and the scorpion waits for the poison to take effect before beginning its meal.

The scorpions of Southern California are not nearly so large as many tropical varieties, some of which attain a length of 185 mm. or over $7\frac{1}{2}$ inches; but as a rule the effects of the sting of the smaller kinds are more poisonous than those of the larger.

The scorpion-spiders are strictly nocturnal in their habits, as their name *Solifuga* indicates. They feed chiefly on ants, and hence do not need poison so much as activity, to enable them to secure their prey. Their speed is simply astounding, and they are by far the swiftest of all the Arachnida. They flit about like shadows, and for this reason it is no easy matter to secure them. Nor are they very common except in desert and sandy localities.

The Phrynichidæ are more sluggish than the preceding; and hunt in much the same fashion as does the toad. An insect will alight, apparently well out of range; but the extraordi-

narily long grappling hooks, usually carried well back in a line with the head, are shot out—like the toad's tongue—much further than would at first sight appear possible, and rarely miss their aim.

All the Arachnida, despite their preference (in many cases) for dry localities, must have water, or moisture in one form or another; and scorpions in particular are much more active after rain.

The appearance of these groups is undeniably repellent; and the remark is not seldom heard that, were a scorpion as big as an elephant, he would make existence impossible for all other forms of life. But most people either do not know, or else overlooks the fact that, whilst weight increases by cubes, strength increases by squares only. So that, in conformity with this law, if a scorpion were as big as an elephant, he would be crushed by his own weight, and—consequently—would be powerless to harm!

We may next consider the equipment of the Arachnida for defense. Their best protection lies in their powers of offense; still, they possess various defensive artifices. To some, Nature has given an appearance which alone says, "Hands off!" Others, like many insects, are protectively colored. Of such are some of the large oriental Mygalomorphae, or so-called bird-eating spiders. These, on rearing up on the hind legs in a posture of defense, display a striking band of pale yellow or red on the under side of the fore part of the abdomen, which may serve as a danger-signal to warn off enemies. Others are imitative. Dr. McCook describes an American spider which resembles the excreta of birds; and nearly all of the order can simulate death, and keep up the deceit for a considerable time. In the East Indies I have seen a very small black spider which lives in the nests of a species of small black ant. These it resembles so closely, that only the minutest observation makes it possible to detect its real nature, which is revealed when the number of the legs is counted. So far as my observation goes, an example of true commensalism (or community of life) is here afforded, for ant and spider appear to live together in perfect amity, neither molesting the other. The trap-door spiders are, of course, protected by their tube, and by the difficulty of detecting the trap-door, which usually exactly imitates the immediate surroundings. The common Californian *Cteniza* can, moreover, keep her door shut from within, by anchoring her hind-legs to the lining of her tube, and by inserting the claws of the forelegs into notches in the lid or door; in which position she can offer a vigorous resistance to an intrusive knife-blade.

Some spiders and scorpions have the power of stridulation; the stridulating organ being composed of spines and clubshaped hairs, situated, in the spiders, between the fangs and the base of the palps; in the scorpions, between the pincers and the basal joint of the first pair of legs. In the case of an African scorpion (*Parabuthus*), the animal possesses the power of—as it were—playing the mandolin; which it does by striking the point of the sting along prominent striations or ridges situated on the keels of the first and second caudal segments. This sound, like the rattle of the snake, serves to warn enemies of the dangerous nature of the animal which produces it. It has been contended that this stridulation is in the nature of a sex-call; but this is a disputed point, and is at least open to question; since the *Arachnida* have no organ of hearing, such as is situated in the antennule of the lobster; or the tympanum which in some crickets is placed in the foreleg, in others above the insertion of the wing. Yet it seems that spiders are to some extent sensitive to vibrations of air or substance. I have, by striking the pavement as far as 3 feet off the largest of the Californian spiders, *Eurypelma* (commonly but incorrectly called the tarantula), obtained a response in the shape of the assumption of a defensive attitude. *Cteniza* will run up her tube and hold down the trapdoor, if the outside of it is gently scratched. And Dr. McCook has caused spiders to respond to the vibrations of a tuning fork. It is likely that this perceptive sense, in the absence of an auditory organ, resides in the setæ, or long specialized chitinous spines, seated in pits or depressions of the exo-skeleton. These differ in structure from true hairs, and are present, in greater or less degree, in all the orders under consideration. These different protective devices are needed by the *Arachnida*, in spite of their formidable weapons; for they have various enemies more powerful than themselves. Chief of these are (apart—of course—from birds) various species of wasps and flies. In California, the most conspicuous of these, by reason of its size and brilliant coloration, is the “tarantula-hawk”—*Pepsis formosa*—which attacks the *Eurypelma*, an *idahoensis*—I believe—the trap-door spider. Not the wasp, however, but its larva, feeds on the victim, which is paralyzed but not killed. An egg is then deposited on or in its body, which is then buried. The larva hatches out in due time, and feeds on the living but helpless body of its unwilling host. I had an opportunity of observing an attack made by *Pepsis* on an *Eurypelma*. The vigor and directness of the assault were remarkable; and the spider seemed to realize the hopelessness of resistance; for it huddled up helplessly, as does a rabbit when pursued by a ferret, and made no attempt to defend itself.

Paralysis appeared to follow immediately on the insertion of the sting.

On any warm summer morning a very active and brilliant blue wasp, not so large as *Pepsis*, may be seen hunting in the long grass for the *Lycosidæ* and smaller ground-spiders.

Thus even the well-armed spider, the terror of the insect world, and therefore the useful ally of man, has her conqueror; and such is the case throughout the insect world. I do not know, however, of any enemy that can subdue the repellent scorpion, except the aggressive black small boy, who will catch two of them and make them fight to the death, when he usually annihilates the survivor! And his elders sometimes make a sure-thing cure for sore eyes by suspending a live scorpion at the end of a string over a slow fire; and the scorched body is then applied to the affected organs.

As regards the reproduction of their species, the *Arachnida* offer perhaps the most interesting study of the mechanics of propagation to be found in the animal kingdom; and this has been exhaustively worked out by Professor and Mrs. Peckham. In this paper, however, I will only allude to one aspect of this important aim of their existence. Throughout the *Arachnida*, with hardly an exception, the male is considerably smaller and less powerful than the female. He is seldom more than 2-3 ds. her size, in some cases very much smaller. But his legs are longer in proportion to the size of the body than his mate's, hence he is the more active of the two. The reason of this is that the period of courtship is the most critical time of his life. To be successful in his suit, he needs the tact of a—Governor of Jamaica, and the speed of a Dan Patch in case he falls short in the former requisite. For should his advances be ill-timed, his more powerful spouse, being—like Socrates' wife—somewhat short-tempered, at once attacks him; and should he fail in speed, she solves in one operation the double problem of domestic supremacy and domestic economy, by killing and eating her luckless mate. Hence, being the smaller of the two, the male's only safety lies in superior activity, which is provided by the longer legs and lighter body.

It is worth noting, in taking leave of the subject, that though the orders which I have attempted to describe, as fully as possible in the limits of this paper, have not been very generally studied, yet the interest which the class as a whole has aroused in men of all epochs is remarkable. The spider-folk and their kin appear in the literature and folk-lore of many lands; from the classic and presumptuous *Arachne*—who gave her name to the *Arachnida*—and thus survives as an awful example, to the historic and somewhat one-sided partnership between King

Bruce and the spider. I have sometimes wondered if Bruce was grateful and considerate enough to avoid destroying, as he left the cave, the web of the wee animal whose industry was, though unconsciously on her part, the means of saving him from discovery and death. The scorpion has, of course, been immortalized in the Zodiac, and was even made to do duty as a double sign therein by the earlier Greek writers. It appears also on Assyrian astronomical cylinders.

Having tried to show, by description and diagram, how the various types of Arachnida have evolved their weapons from the primitive ancestral form, let me conclude by telling you how the ingenious Oriental accounts for the scorpion's sting. Thus runs the tale, as I heard it in Ceylon:

Whilst the lord Buddha sat one day in meditation under the sacred bo-tree, the scorpion—who was in those days stingless, appeared before him, complaining that for him life was unbearable; since his wife, the spider, had a sting in her mouth; whilst he, being weaponless, could not retaliate. He prayed, therefore, that Buddha the compassionate would arm his mouth in like manner. But the all-wise Buddha replied: "Not so: for with two poisoned mouths in a family, neither member could survive. Moreover, it is the nature of woman-kind ever to carry a sting under the tongue; but this is not so with the man, whose strength is in his body. Yet, for thy safeguarding, I give thee from henceforth a sting in thy tail; and learn thereby that, in a contest with thy wife, thy safety lies in turning thy back on her."

I will not assume, however, that the Oriental version is likely to be accepted in preference to the more prosaic explanation of Western science!

The Changes in Our Weeds.*

A. Davidson, M. D.

In March, 1893, the writer published some notes of "Erythrea" on the distribution and relative frequency of the immigrant plants in Los Angeles county. Nearly fourteen years have passed since then, and it is interesting to note the changes that have taken place among our weeds in this period of time. None of those then observed have become extinct; the relative frequency of the majority have remained unchanged. Some have increased in numbers, and a few new ones have appeared. Among those on the increase are **Melilotus alba** Lam. and **Cotula australis** Hook. **Bromus rubens** L. & **B. maximus** Desf. The former, rare and local at that time, has considerably increased in the original localities, and may now be found in scattered patches in many parts of the country. **Cotula Australis** Hook, then limited to a single locality at Sierra Madre, is now to be found in many moist shady places along the public streets of Los Angeles.

Bromus rubens & **B. Maximus** have much increased, and have extended their range to the foothills of the Mojave Desert.

The new weeds that have appeared since 1893 are, **Salsola Kali. tragus**, **Galinsoga parviflora**, **Lactuca scariola**, and **Piaropus crassipes**, Britton... **Salsola kali. tragus**, Linn., I first observed at Lancaster in 1893. It was then fairly abundant in the neighborhood, and rapidly spread over the country. The county supervisors have made a few spasmodic attempts to eradicate it, but it does not threaten to become a serious pest. **Galinsoga parviflora**, first discovered by F. Branton at Vernon avenue in 1903, has rapidly extended along the irrigation ditches into the southwest of the city, but is not troublesome.

In the autumn of 1896 I found near University Station in this city two plants of **Lactuca scariola**, L., the prickly lettuce of Europe. That same season Mr. Branton reported it from near Compton, where it was quite troublesome in one place. Since that time it has spread so rapidly that it may now be considered the most troublesome weed in this district. In luxuriance and density of growth it rivals the black mustard. On Sunset boulevard there is a large dense patch of mustard that has become invaded by the prickly lettuce, and I am interested in watching which will ultimately predominate. As the mustard attains its growth in the spring and the lettuce in the autumn, it is possible they may both continue to thrive together. Time will tell. Mr. S. B. Parish writes that he noted

*Read before the Botanical Section Feb. 14, 1907.

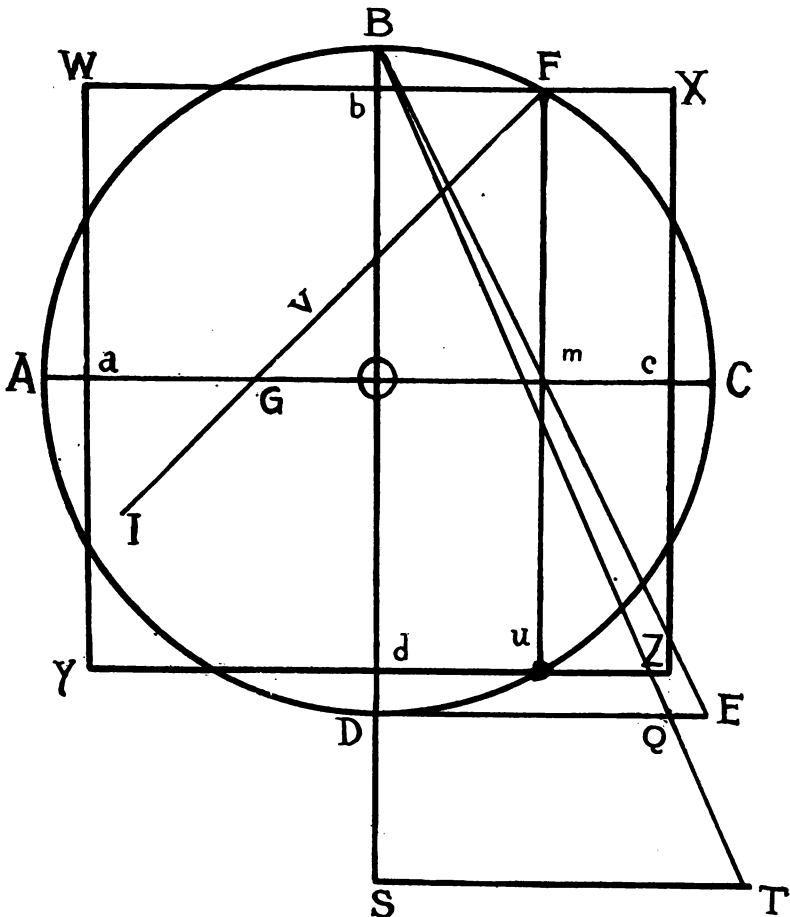
its first appearance in San Bernardino in 1895, and says it threatens there to be more troublesome than the mustard. This lettuce when eaten by cattle gives a disagreeable odor to the milk, to the great discomfort of the dairymen. On the other hand, it is a welcome food for poultry, turkeys being particularly fond of it. In 1904 I observed in some pools of the Los Angeles River near Hynes large quantities of the water hyacinth, **Piaropus crassipes**, Britton, the pest of the Florida rivers. Mrs. Lawrence has specimens from the San Gabriel River. This had evidently been established here for a few seasons before we discovered them. The heavy floods of this season have probably washed them away; the lack of water will prevent them ever being troublesome.

Squaring the Circle.

The Nearest Approximation, by R. H. Chittenden.

DIRECTIONS.

1. Divide the Circle, $A B D$, in quadrants by the diameters $A O C$ and $B O C$.
2. Draw $D E$ equal to and parallel to radius $O C$.
3. Draw $D E$, bisecting $O C$ at m .
4. With C for a center and radius equal to $O C$, cut off the arc $C F$.
5. Draw $F m$ and make $G m = F m$.
6. Draw $F G$.



7. Produce B D to S making D S=O m.
8. Draw S T parallel to D E and equal to B m.
9. Draw B T, intersecting B T at Q.
10. Produce F G to I making G I equal to Q T.
11. Bisect F I at V and from the center O locate the points a, b, c, and d, making O a=O b=O c=O d=F V.
12. Through a, b, c, and d draw the sides of the square W X Y Z.

DEMONSTRATION.

Since F C is the arc of 60° , F m, the Sine of 60° equals

$$\text{radius} \times \frac{\sqrt{3}}{2}$$

Since G m equals F m and G m F being a right angle, F G

$$\text{equals radius} \times \frac{\sqrt{6}}{2}$$

Since D S is 1-5 of B S and the triangles S B T and D B Q are similar, Q T equals 1-5 of B T.

Since D E equals radius B E=radius $\times \sqrt{5}$ and S T equals $\frac{1}{2}$ of B E.

Hence B T equals $\frac{1}{2} \sqrt{30}$ and Q T= $1-10 \sqrt{30}$,

$$\text{Therefore F I equals radius} \times \left\{ \frac{\sqrt{6}}{2} \times \frac{\sqrt{30}}{10} \right\}$$

$$\frac{\sqrt{6}}{2} = 1.22474487$$

$$\frac{\sqrt{30}}{10} = .54772255$$

$$\text{Sum} = 1.77246742$$

$$\sqrt{3.1415926} = 1.77245385$$

$$\text{Difference} = .00001357$$

Since the area of a circle equals the product of the square of its radius and 3.1415926+ or P, it follows that when the radius is 1 the area=P, and the side of the required square $\sqrt{P}$. If the radius be any other number greater or less than 1, denoted by R, the side of the square is $R\sqrt{P}$.

The negligible difference, .00001357 for the length of the side of the square for the length for a 122 feet circle is **less than 1-100 of an inch.**

This method does not require the use of any instrument or mechanical device except a pair of compasses and a straight edge.

THEOREM.

The side of the square is the mean proportional between the arc of the quadrant and the diameter.

DEMONSTRATION.

When the radius is R. The area of the circle = R^2P and the side of the square = $R\sqrt{P}$.

$$\begin{array}{ccccccc} \text{The arc of the quadrant} & = & \frac{2RP}{4} & = & \frac{RP}{2} & \text{and} & \\ \text{Arc of } 90^\circ & & \text{Side} & & \text{Side} & & \text{Diameter} \\ \frac{RP}{2} & : & R\sqrt{P} & = & R\sqrt{P} & : & 2R \\ \text{or } \frac{P}{2} & : & \sqrt{P} & = & \sqrt{P} & : & 2 \end{array}$$

R. H. C.

The Length of Jupiter's Day.

Jupiter's axial rotation period according to Newcomb is 9 hours 55 min. 37 sec. (See Encyclopedia American).

Assuming that 92,996,000 miles is the true value of the astronomical unit.

The product of Jupiter's sidereal period mass and mean diameter is the length of his day. viz:

$$\begin{array}{ccccccc} \text{d.} & \text{mass.} & \text{diam.} & & \text{d. sidereal} & & \\ & 1 & 86552 & & & & \\ 4332.58 \times \frac{1}{1048} \times \frac{86552}{867450} \times 1.0027379 & = & .413623668 & = & & & \\ \text{h.} & \text{m.} & \text{sec.} & & & & \\ 9 & 55 & 37.08 & \text{sidereal time.} & & & \end{array}$$

Observe that in the foregoing equation the mass and mean diameter of Jupiter are expressed in solar terms.

Also that to reduce a time interval in mean solar time to sidereal time it is necessary to multiply by 1.0027379.

R. H. CHITTENDEN.

Urbita, Oct. 18, 1906.

The Cycle Theory of Disturbances.

About the year 1825 Heinrich Samuel Schwabe, an amateur astronomer of Dessau, Germany, began to observe and record sun-spots. He pursued his investigation for twenty-five years, and, in 1851, published the results of his labors. From the mass of data thus presented, a periodicity in sun-spot phenomena was first established. The subsequent investigations of Prof. R. Wolf of Zurich, and others confirmed the observations of Schwabe, fixing the period from maximum to maximum at approximately 11 1-9 years.

The cause of sun-spot phenomena has been studied with great care by De La Rue, Stewart and other investigators, who have promulgated theories assigning them to the influence of various planets in the solar system, or to the joint influence of several planets when in conjunction; but the theories thus proposed have not been accepted by the scientific world, because they were not considered as conclusively proven.

In 1850 Lamont, of Munich, called attention to the fact that there is a regular periodicity in the maxima of magnetic disturbances, as indicated by the variations of the needle, and fixed this period at 10 1-3 years. Subsequent investigations confirmed this theory.

Prof. C. A. Young, [*"The Sun"* p. 163] says: "As soon as Schwabe announced his discovery of the periodicity of the solar spots, Babine in England, Gautier in France, and Wolf in Switzerland, at once and independently perceived the coincidence between the spot-maxima and those of the magnetic oscillation. * * * The convincing evidence as to the reality of the asserted connection lies in the closeness with which, ever since we have been in possession of continuous and satisfactory observations, the magnetic curve copies that of the sun-spots. * * * From 1820 to 1895 the record is almost continuous, and the coincidence of the curves is such as to make it impossible to doubt the connection."

"When Loomis and other investigators came to collate observations of auroræ with those of sun-spots, they found an almost perfect parallelism between the curves of auroræ and sun-spot frequency."

The concurrence of maxima and general convariance of these three classes of phenomena—sun-spots, magnetic disturbances and **auroræ**—have thus been established to the satisfaction of the scientific world. Thus the disturbances in the gaseous envelope of the sun and the electric and magnetic phenomena pertaining to the earth are allied, either in the relation of cause

and effect or of concurrent phenomena assignable to the same cause.

Following the investigations of De La Rue and Stewart in their efforts to attribute the cause of sun-spots to the joint influence of various planets in the solar system, Prof. John H. Tice, Superintendent of Public Schools, of St. Louis, Mo., in 1862 took up this line of research, with the hope of discovering the cause of the 11-year sun-spot period and also of extending the inquiry to see whether there might be a similar periodicity in telluris and atmospheric disturbances. In other words, his hypothesis was that the same great cause lay behind sun-spots, magnetic and electrical disturbances, earthquakes, volcanic eruptions, hurricanes, tornadoes and atmospheric disturbances of all kinds.

This cause he assigned to the equinoctial disturbance proceeding from the various planets of the solar system. After an investigation extending through 12 years Prof. Tice, in 1875, published a treatise on Metrology, setting forth his theory and the results of his observation and research. This treatise, while challenging respectful consideration, is not presented in such a logical and well-digested manner as to be considered convincing testimony in support of his theory.

Therefore. It is a proper line of scientific inquiry to pursue this investigation, and ascertain, if possible, (a) Whether sun-spots are attributable to equinoctial disturbances in the several planets separately or jointly; (b) Whether there is a periodicity in earthquakes, volcanic eruptions, hurricanes, tornadoes and other disturbances, concurrent with the periodicity in sun-spots and magnetic and electrical phenomena.

In the year 1890 I obtained Prof. Tice's work on Metrology and was so much impressed with the theory therein set forth that, from data relative to the equinoxes of several planets, I prepared a chart showing the respective occurrences of such equinoxes from 1890 to 1902. By calculating the electro-magnetic intensity of the solar system for various years during this period it appeared that the year 1902 should bring disturbances of a pronounced character and that the year 1906 should be very extraordinary in this respect. In a paper read before the Teacher's Institute of Los Angeles, December 22nd, 1892, I gave an outline of the Tice theory, and made the following predictions:

"We may not expect to be entirely through with our series of extraordinary disturbances (those which occurred during the years 1891-1892) until about the end of the year 1896. There will be another period of storms and earthquakes, but not so violent or long continued as that we are now passing through, from 1901 to 1903 when Jupiter will have another equinox.

But when the earth reaches the year of grace 1906, it will need to gird up its loins and prepare for a severe visitation. Here you see the influence of the equinox of Saturn is not merged gradually into that of Jupiter as before, but is almost exactly superimposed upon that of Jupiter, and the other planets drop into line with their equinoxes, indicating that their disturbing influences will be united at their maximum in 1906, and the electric tension of our planetary system will be raised proportionately. Then, ladies and gentlemen if there is anything in this system of forecasts, **look out for disturbances of an extraordinary character."**

The foregoing forecasts have been abundantly justified by the events. The year 1902 was one of considerable violence, (eruptions of Mt. Pelee, Soufriere and other disturbances) as predicted nearly nine years previously; the year 1906 has been one of extraordinary violence as predicted nearly fourteen years previously. The accuracy of these forecasts, made respectively nine and fourteen years before the events, challenges further investigation of the Tice theory, to ascertain whether it may not be well-founded and susceptible of conclusive proof.

Proceedings of the Academy.

Nov. 5th, 1906.

The Board of Directors met at 7:30 p. m., present, Messrs. Knight, Collins, Parsons, Whiting and Dozier. In the absence of the President Mr. Knight was chosen Chairman. The name of Ralph B. Clapp, of Alhambra, was proposed for membership in the Academy, being properly recommended he was duly elected after the transaction of routine business, the Directors adjourned for the discussion of the topic for the evening which was a presentation of the engineering and commercial features of San Pedro harbor, by Lieutenant Randolph Miner, U. S. N. The speaker was introduced by Chairman Knight in fitting terms, and proceeded to describe in detail the history and prosecution of the great work projected and now being accomplished at the harbor of San Pedro. The design of the government is to construct a capacious harbor of wide entrance, thoroughly protected from the ravages of storms; not less than forty feet deep at lowwater, and capable of accommodating two hundred and fifty ships at anchor. The speaker entered into particulars concerning the designs, the cost, the capacity, the concessions to make to corporate parties, the progress, and the possibilities of the great undertaking, and predicted a harbor of great commercial value to the world, provided with ample facilities for loading and unloading, repairing and constructing vessels of the largest type, bringing Los Angeles Angeles into direct touch with the great commercial centers of the world.

After the lecture, many questions were asked and answered relative to the subject under consideration, and a vote of thanks was enthusiastically extended to Lieut. Miner for his very lucid, full and valuable contributions to the Academy's knowledge of this important subject. The meeting then adjourned.

MELVILLE DOZIER, Secretary.

Dec. 3rd, 1906.

The Board of Directors met at the usual hour, Mr. Knight presiding and a quorum present.

Bills for the current expenses were prescribed and allowed. It was ordered that the method of collecting dues directly by the Treasurer shall go into effect January first. Messrs. Ezra Crossman and E. E. Eads, M. D., were duly elected to membership in the Academy on recommendation of Messrs. Britain and Whiting.

The Directors then adjourned to the discussion of the subject before the Academy, which was entitled "The Cycle Theory of Physical Disturbances," and which was most ably presented by Mr. Wm. A. Spalding a carefully prepared paper, a digest of which appears elsewhere in this Bulletin. After a general discussion of the subject matter the meeting adjourned.

MELVILLE DOZIER, Secretary.

January 7th, 1907.

After a brief meeting of the Directors this evening, during which only routine business was transacted, the Secretary introduced the speaker of the evening the President of the Academy, Mr. B. R. Baumgardt, who has recently returned from an extended tour of study and observation in Europe. Mr. Baumgardt, in his usual clear and forceful way, proceeded to give a running but corrected account of his most interesting and profitable travels.

In Norway the old "Viking Ship" was made the nucleus about

which clustered much of historic interest connected with the early history and development of that seafaring and hardy people.

In Sweden the astronomical observatories were objects of special interest. The observatory at Stockholm is equipped with somewhat antiquated instruments and suffers much inconveniences because of the brilliancy of the city's illumination at night. The observatory will probably be removed to a more suitable location.

In Stockholm is maintained at public expense an extensive outdoor museum where are exhibited and exemplified the manners and customs of the ancient Scandinavians; keeping the people in visual touch with the history and weapons of their country.

At the University of St. Petersburg is an exhibition the great mammoth, found encased in ice, in perfect preservation. The long and abundant coating of hair proves that it was intended for arctic habitation.

The faculty of this institution comprises men of great fame as mathematicians and scientific inventors.

The Astronomical observatory at Pulkov, Russia, is the best equipped in Europe, special attention being given to the determination of the parallax of the stars. Here was found a copy of the Bulletin of the Southern California Academy of Sciences. At Vienna the chief interest clusters about the lives and tombs of the great Musicians, such as Beethoven and Mozart.

In London, the Greenwich observatory was found to be well equipped, especially with men, there being more than sixty on the observatory staff. But the atmosphere is poorly adapted to astronomical work. The most delightful hours of the speaker's travels were spent in visiting the Royal Society and the Royal Astronomical Society, especially as he came into close touch with the life-work of the great Sir Isaac Newton. In Florentian history the most interesting figure is Galileo, where his villa, his tower, his telescope, his tomb, and his fame are sacredly guarded and revered.

Here, too, Bruno suffered death at the stake in 1600 for claiming a plurality of worlds.

After the Lecture the speaker responded to many questions from interested auditors, and the meeting adjourned.

MELVILLE DOZIER, Secretary.

February 4th, 1907.

At the regular meeting of the Directors this evening there were present Messrs. Baumgardt, Collins, Davidson, Keese and Dozier.

The ordinary bills were allowed and routine business transacted, whereupon the meeting adjourned to participate in the exercises before the Academy.

President Baumgardt appropriately introduced the speaker of the evening Prof. Rev. Ritchey of the Mount Wilson Observatory, whose mechanical skill and scientific knowledge are contributing so largely to the successful development of the great enterprise undertaken in our immediate vicinity. After giving an account of the difficulties that beset the construction of this most important observatory, especially that of conveying material to the top of the mountain, Prof. Ritchey explained and illustrated the method of preparing the great lenses for practical use after they have been cast, calling special attention to the vast possibilities that await the completion of the one-hundred-inch lens provided for by the magnificent gift of our Vice-President, Mr. John D. Hooker. The speaker then proceeded to speak of the comparative value of photographic and visual methods of observation in astronomy, the former

being specially adapted to long exposures of faint objects, while the latter served best in the observation of bright objects.

The stereopticon was then brought into use, and the glories of the heavens revealed in a way to entrance the soul and to overwhelm one with the realization of the infinite magnitude of God's creation. Suns, planets, satellites, starclusters, and nebulae, in all the grandeur of their brilliancy and infinitude, were thrown upon the screen and lucidly explained to the extreme delight and fascination of the audience.

Very many of the pictures were the result of Prof. Ritchey's own observation and development, and they rank among the best that can be found in the world. A vote of thanks was extended to the speaker for his instructive and uplifting address, and the meeting adjourned.

MELVILLE DOZIER, Secretary.

March 4th, 1907.

For the lack of a quorum present, no Directors' meeting was held this evening. In the absence of the President, The Secretary introduced the speaker of the evening, Dr. Holdridge O. Collins, who discussed the subject, "The Planet of Jupiter," in all of its phrases. The speaker said in part: "Of the eight planets circling our Sun, the great monitor is Jupiter. Great by reason of his immense bulk, his intense brilliancy, and above all by reason of the influence he has upon human life on our globe in furnishing the first certain means of measuring the velocity of light, and the longitude on exact location of places relative to each other.

His density is only one fourth that of the earth; and, were all the known planets assembled in one body, their combined mass would be only two-thirds of that Jupiter. His rotation is accomplished in about 9 hours and 56 minutes, while his revolution about the sun consumes 11 years and 314.92 days of our time.

Jupiter being inclined but a little more than three degrees to the plan of his ecliptic, the variation of seasons and in the length of day and night is exceedingly small; but as the mean density of Jupiter is nearly the same as that of the Sun, it seems not unnatural to suppose that the planet is intensely seated, and that this inherent heat is what produces great changes in its atmosphere. Another reason for believing Jupiter to be incandescent is that the light secured from him is far in excess of what he would reflect if his surface was like that of the Moon.

Jupiter therefore, cannot be the scene of animal or vegetable life. The conclusion may not be true of the four chief satellites of Jupiter, whose conditions may reasonably be compared to those of the four planets nearest to the Sun.

The late discoveries in the solar system have excited intense interest, and with the increase of power in new reflectors and refractors, this generation may come to some accepted conclusion as to the existence of life upon other worlds of our system.

The speaker went with minuteness into descriptions of Eros and its orbital peculiarities, and of the body :T. G.'" in its remarkable relations to the planet Jupiter, the entire lecture being replete with important facts and suggestive theories.

At the close of the lecture a brief discussion ensued. The Secretary read a statement from Chief Justice Melville W. Fuller, Chancellor of the Smithsonian Institution, announcing the appointment of Charles Doolittle Walcott, L. L. D. as Secretary of the Institution, to succeed the late Camuel Pierpont Langley.

The Secretary also read a communication from the International Zoological Association, writing the Academy to participate in the Seventh

Congress of the Association to be held in Boston, Mass. August 19th to 23rd 1907. The meeting then adjourned.

MELVILLE DOZIER, Secretary.

Section Meetings.

Los Angeles, Cal., Nov. 12, 1906.

The regular meeting of the biological section of The Southern California Academy of Sciences was held on the above date, in the Histological Laboratory of the Pacific College of Osteopathy. The meeting was called to order by the chairman.

The minutes of the last meeting were read and approved.

Dr. Whiting gave a short talk on the scope of the Academy and its work. In response to a call for voluntary reports upon scientific subjects, Dr. Whiting reported on the work of experimenting upon animal organisms and their relationship to disease.

Dr. Bebb of the Dental College was introduced as the speaker of the evening. Dr. Bebb spoke on the subject, "Teeth," illustrating his talk with some excellent lantern slides, showing the abnormal and normal dentition of both man and animals. In the course of his talk, Dr. Bebb said he expected the time to come, when a cause and a cure should be found for that most prevalent of all human maladies, Caries of the Teeth.

This most interesting and instructive talk was enjoyed by about thirty members and visitors.

After some discussion and questions, the meeting was adjourned.

CHARLES H. PHINNEY, Secretary.

Los Angeles, Dec. 10, 1906.

The December meeting of the biological section of the Southern California Academy of Sciences was held at the Pacific College of Osteopathy on Monday evening, December 10.

After the reading of the minutes of the previous meeting and regular business, Dr. Whiting spoke of the award of the Nobel prize.

Dr. E. L. Leonard gave the talk of the evening, taking as her subject "Immunity." All the forms of immunity were carefully reviewed and discussed, and especially the bearing of serum-therapy upon immunity. The taking of and the value of the Opsonic Index were fully discussed and explained.

A number of questions were asked Dr. Leonard and answered fully.

Fifty persons, members and visitors, were present.

CARLE H. PHINNEY, Secretary.

Los Angeles, Cal., Jan. 14, 1907.

The January meeting of the biological section of the Southern California Academy of Sciences was held at the Pacific College of Osteopathy, Monday evening, Jan. 14.

After the reading of minutes and announcements, Prof. Gilbert of the High School was introduced as the Speaker of the evening. Mr. Gilbert gave an extremely interesting talk on the Unicellular Organisms, illustrating the various forms with a large number of excellent lantern slides.

In spite of the very stormy evening, about thirty were present.

No business being presented, the meeting adjourned.

CARLE H. PHINNEY, Secretary.

Los Angeles, Cal., February 11, 1907.

The regular February meeting of the Biological Section of the Southern California Academy of Sciences was held on Monday evening, February 11, 1907.

After the regular routine of business, Mr. Fred C. Luck, a naturalist, whose home was for a number of years on the Island of Ceylon, was introduced as the speaker of the evening. Mr. Luck spoke on our native spiders. The lecture was most interesting, and was illustrated by a number of drawings made expressly for this meeting.

A large number of members and visitors were present.

C. H. PHINNEY, Secretary.

The Botanical Section met in the Wilcox Block February 14, 1907.

Dr. Davidson read some notes on the "Changes in Our Weeds."

Mrs. Lawrence showed a large number of plants from Arizona.

THEODORE PAYNE, Secretary.

The February meeting of the Astronomical Section was held on February 18, 1907 at the residence of Mr. B. R. Baumgardt.

Mr. William A. Spaulding read a paper upon "Periodicity in Terrestrial Disturbances Due to Cosmic Forces," which was an amplification of his late address before the Academy in Symphony Hall, and from which conclusions were drawn relating to the Seismic disturbances of 1906.

HOLDRIDGE O. COLLINS, Secretary.

BULLETIN

OF THE

Southern California Academy of Sciences



Committee on Publication:

Melville Dozier

A. Davidson, C. M., M. D.

Wm. H. Knight

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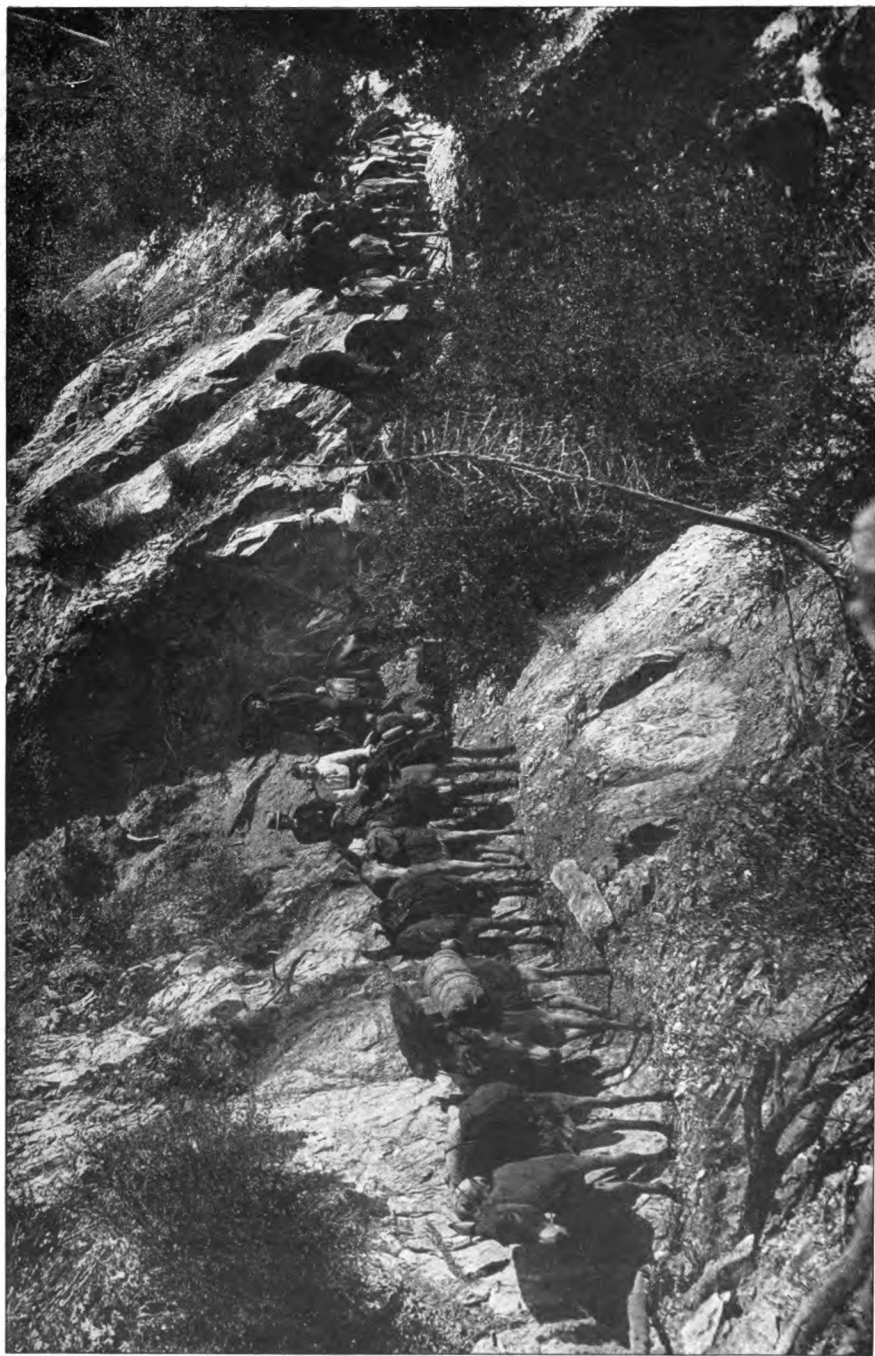
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Wilson Trail, in the heart of the Sierra Madre Mountains. On Mount Wilson is being constructed the largest telescope in the World.

CORPORATION AND OFFICERS

The Academy of Sciences of Southern California has become an incorporated body under the laws of the State of California, and is legally entitled to all the rights and privileges and clothed with all the responsibilities that attach to public corporations in this State. It has done a noble work in the past in its more limited sphere. It is hoped that some of the ardent lovers of science in this favored clime will contribute of their wisdom and substance toward securing for the Academy a permanent home, where such a collection of scientific data, specimens and literature may be housed as will be a credit to Southern California and the scholarship it represents and fosters. Many donations of immense interest and of permanent value would be forthcoming if a suitable place were provided for their proper care and preservation. With such facilities for work as are appropriate, the Southern California Academy of Sciences would soon be recognized as among the most active and efficient instruments of popular instruction and moral influence in this community.

The following officers of the corporation were elected to serve during the first year, terminating June, 1908:

President—B. R. Baumgardt.

First Vice-President—Wm. H. Knight.

Second Vice-President—John D. Hooker.

Secretary—Melville Dozier.

Treasurer—Saml. J. Keese.

Other Directors—Holdridge O. Collins, Anstruther Davidson, George W. Parsons, G. Major Taber, John Vosburg, Clement A. Whiting.

The Board of Directors has adopted and had printed on very durable and substantial paper an appropriate form of "Certificate of Fellowship," to be properly signed and sealed and delivered to each member of the Academy upon whom has been or shall be conferred the degree of Fellow. The following is a complete list of Fellows of the Academy at the present date:

List of Fellows of the Academy.

Prof. Paul Arnold	Dr. Alfred Fellows
Dr. C. A. Bailey	Chas R. Fletcher
B. R. Baumgardt	Jas A. Foshay
Dr. H. M. Bishop	O. K. Goodwin
G. A. Bobrick	Dr. Jno. R. Haynes
C. B. Boothe	A. S. Hoyt
Prof. F. P. Brackett	Dr. West Hughes
Dr. Norman Bridge	John D. Hooker
Dr. F. D. Bullard	Dr. J. C. Hunt
W. A. Butterworth	Irving E. Ingraham
C. J. Callahan	Dr. J. H. Johnson
Wm. J. Canfield	Abbot Kinney
Dr. Edith J. Claypole	Wm. H. Knight
Holdridge O. Collins, LL.D.	A. H. Low
Dr. Anstruther Davidson	Malcolm Macleod
Dr. H. J. Davis	Dr. A. L. McLeish
Melville Dozier	Dr. F. C. E. Mattison

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Prof. E. S. McClelland
Dr. J. D. Moody
Dr. J. C. Nevin
Geo. W. Parsons

W. C. Patterson
Dr. Theo B. Comstock
Mrs. T. A. Rendall
Paran F. Rice

Wm. L. Watts.

Life Members of the Academy.

Theodore B. Comstock

Wm. L. Watts

John D. Hooker

Reports of Officers

REPORT OF THE SECRETARY OF THE ACADEMY FOR THE YEAR 1906-07.

The Academy has made material progress during the year just closing, and has every indication of a brighter future than at any time in the past.

The following persons have been elected to membership during the year: Prof. James Stirling, F. W. Jones, Ralph B. Clapp, Ezra Crossman, E. E. Eads, Geo. W. Currier, Oswald Granicher, Dr. F. Clark, F. P. Brown, Dr. Chas. E. Case and J. R. Haskin. The present active membership of the Academy numbers about one hundred and sixty.

The meetings of the Academy during the year have been of more than usual interest and practical value, and have been attended by appreciative audiences.

At the October meeting Mr. Wm. H. Knight presented the plans and engineering features of the Panama Canal in a graphic and instructive lecture, illustrated by maps showing the work accomplished and to be accomplished in this greatest of the world's enterprises.

The November meeting was devoted to the consideration of the subject of San Pedro Harbor, so closely connected with the commercial expansion and future greatness of our city and section. The subject was most ably treated in an exhaustive lecture by Lieut. Randolph Miner, who went with much detail into the plan of operations, the design to be accomplished, the progress of the work, the cost already met and to be yet provided for, and the promise of development necessarily involved in the great undertaking. Lieut. Miner regards the San Pedro Harbor, when completed, as one of great commercial value to the world at large, provided with ample facilities for loading and unloading, repairing and constructing vessels of the largest type, and bringing Los Angeles into direct touch with the great commercial centers of the world.

The December meeting was given to the consideration of the "Cycle Theory of Physical Disturbances," most ably presented by Mr. Wm. A. Spalding in a lecture replete with thoughtful research and astronomical investigation. The speaker discussed with much clearness and erudition the relation between magnetic disturbances in the solar system and concurrence of planetary equinoxes, and called attention to the forecast he had made in 1892 to the effect that in the year 1906 the relative position of the planets would be such as to cause great magnetic and electrical tension, resulting in violent earthquakes in different parts of the world. The remarkable fulfillment of this prediction with such disastrous results in our own country and others gave added interest to Mr. Spalding's address, and the theory it was designed to elucidate.

At the January meeting the audience was entertained and enlightened by an interesting and instructive recital of observations and travel in Europe by the president of the Academy, Mr. B. R. Baumgardt, then just returned from a trip abroad. His remarks were devoted largely to matters of scientific interest in foreign lands, especially along the lines of astronomical research and progress.

The meeting in February was one of unusual richness in the impartation of knowledge and the fascinating interest of the subject presented.

Prof. R. W. Ritchie of the Mount Wilson Observatory, whose mechanical skill and scientific knowledge are contributing largely to the successful development of the great enterprise undertaken in our immediate vicinity, was the speaker of the evening, and his topic was the comparative value of photographic and visual methods of astronomical observation. During this clear cut and luminous presentation of facts the stereopticon was brought into use, and the glories of the heavens revealed in a way to entrance the soul, and to overwhelm one with the realization of the infinite magnitude and harmony of God's creation. Suns, planets, star clusters and nebulae, in all the grandeur of their brilliancy and infinitude, were thrown upon the screen, and lucidly explained, to the extreme delight and fascination of the audience.

During this lecture most gratifying reference was made to the marvelous possibilities anticipated by astronomers on the completion of the great one-hundred-inch lens, munificently provided for by Mr. John D. Hooker, the vice-president of the Academy; a matter which appeals intensely to the pride and gratification of the Academy.

The March meeting of the Academy was devoted to an address on the planet of Jupiter, by Mr. Holdridge O. Collins, LL.D., a member of the board of directors, and a valuable contributor to the highest interests of the Academy. The speaker discussed the giant planet of our system in all of its phases, entering minutely into the detail of its physical conditions, periodicity, influence and probable history, past and future. The lecture was full of practical and valuable information, and was greatly enjoyed.

The April meeting of the Academy was addressed by Dr. A. Davidson, also a member of the directorate, and for years the leading spirit in the Botanical Section of the Academy, choosing for his subject, "Early Man in Europe." The speaker made clear distinctions among the earliest races of men, the paleolithic, the neolithic, the Celtic, etc., and with the aid of the stereopticon presented evidences of man's development into a condition of civilization from a state of barbarism, and expressed the opinion that all real progress in civilization has emanated from those portions of the human family who have lived in tropical or semi-tropical climates, where men were not compelled to exhaust their energies and consume their time in procuring necessary food.

The May meeting of the Academy was given to a discussion of the topic now uppermost in the minds of our citizens, the Owens River aqueduct. The subject was presented by Mr. J. B. Lippincott, assistant chief engineer of the project, in a most interesting statement relative to the great undertaking, the country it will traverse, its viaduct, flumes, pipes, tunnels, manner of construction, and estimate of expenses. His discourse was illustrated with maps, charts, profiles and views along the region of its course, thrown upon the screen, and the explanations were supplemented by remarks from Mr. Wm. Mulholland, chief engineer, whose identification with the enterprise dates from its inception. Much interest in the subject was manifested by the audience. It was announced that the final meeting of the Academy for the season, to be held in June, would be addressed by President Baumgardt on "Russia and Her Scientific Men," and that a special program would be prepared for that occasion, to which admission would be by card only.

Since the May meeting a very important step has been taken in the history of the Academy by organizing it into an incorporated body,

with all the legal privileges and responsibilities that attend such an organization.

The members of the Academy in its former associational character have been made members of the Academy in its corporate capacity, and the Fellows of the Academy have been made Fellows of the new, with certificates of Fellowship, signed and sealed in proper form and ready for delivery to those entitled to them.

The following are the officers and directors of the corporate body: President, B. R. Baumgardt; First Vice-President, Wm. H. Knight; Second Vice-President, John D. Hooker; Secretary, Melville Dozier; Treasurer, Saml. J. Keese; Directors: Dr. A. Davidson, Geo. W. Parsons, G. Major Taber, Dr. C. A. Whiting, Holdridge O. Collins and John Vosburg.

For the legal services necessary to effect this change, carefully and gratuitously given, the Academy is indebted to Mr. H. O. Collins, of its Board of Directors.

In its efforts to popularize scientific investigation, we bespeak for the Academy the confidence and co-operation of the citizens of our fair city.

MELVILLE DOZIER, Secretary.

ASTRONOMICAL SECTION.

To the Academy: I have the honor to report the proceedings of the Astronomical Section for the current year, 1906-1907:

There have been six meetings, at all of which valuable papers were presented, and at which the members generally participated in interesting discussions.

On May 21, 1906, the chairman, Mr. Wm. H. Knight, tendered some reflections upon "Cosmic Influences in the Production of Earthquakes," suggested by the late terrestrial disturbances in San Francisco, and the predictions of several years ago by Mr. William A. Spalding of this Academy.

October 15, 1906, Mr. Knight presented all the known facts concerning the newly discovered asteroid, T. G., which was first detected upon a photographic plate at Königstuhl on March 3, 1906, and seen March 5, 1906, through the refractor at Vienna by Palisa.

November 19, 1906, Prof. Dozier read a paper on the "Sources of the Sun's Heat," by Prof. John F. Lanneau of Wake Forest College, North Carolina, originally presented May 18, 1906, before the North Carolina Academy of Sciences.

In view of the approaching close opposition of Mars, Mr. Knight read a most interesting paper upon that planet at the meeting of January 21, 1907. This article was subsequently published in full by the Los Angeles Times.

At the meeting of February 18, 1907, Mr. William A. Spalding delivered a lecture upon "Periodicity in Terrestrial Disturbances, due to Cosmic Forces," which was an amplification of his address before the Academy in Symphony Hall, and from which conclusions were drawn relating to the seismic disturbances of 1906.

On April 15, 1907, Prof. Dozier read an article on "Physics of the Shooting stars," by Prof. Lanneau of Wake Forest College, North Carolina.

No meetings of the section were held in the months of June and December, 1906, nor in May, 1907. Very great interest has been taken in the working of this section during the last year, in view of the late remarkable discoveries, and the eminent astronomers at the Lick

and Harvard observatories have most cheerfully and generously responded to our communications. We hope to secure from Prof. William Hammond Wright of Lick Observatory a paper upon Eros, which asteroid he has been studying during the last two years from the observatory in the Andes of Chile, where he was sent by the State University for this work.

The Academy has been presented with a very valuable refractor of .4½ inches objective, which is now in the possession of this section, and with which much good work has been done, and it will be in use by members during the opposition in July of Mars.

Respectfully submitted,

HOLDRIDGE O. COLLINS,

Secretary of the Astronomical Section.

Los Angeles, Cal., June 5, 1907.

BIOLOGICAL SECTION.

The interest shown in the affairs of this section of the Academy has been very gratifying to its members. Ten successful regular meetings have been held during the past year, which must be understood to exclude July and August. The average attendance at the meetings has been about twenty-five persons, including visitors. The speakers have been:

Prof. E. R. Miller of the Normal School.

Prof. Ulrey of the University of Southern California.

Dr. Bebb of the Dental College.

Dr. E. L. Leonard, City Bacteriologist.

Prof. Gilbert of the High School.

Mr. Fred C. Luck of Whittier.

Dr. C. A. Whiting, the chairman of the section, and

Prof. N. C. Gardiner of the Polytechnic High School.

Among the subjects have been the following:

The Life History of the Salamander, *Autodax*.

Some Problems of Inheritance.

Teeth.

Immunity.

The Reptiles of Los Angeles County.

The Unicellular Organism.

The Native Spiders.

The Physiology of the Cell.

This series of lectures has aroused an interest and called out an attendance which entitles the Biological Section to take a high rank as a scientific association.

At the May meeting the officers for the past year were re-elected, and the prospects for another year of good work seem bright.

C. A. WHITING, Chairman.

BOTANICAL SECTION.

The Botanical Section has held three meetings this season, all of which have been chiefly devoted to the examination and determination of herbarium specimens from California and Arizona.

Two papers have been formally read, viz: "A trip to Rock Creek," and "Some Changes in Our Weeds."

As the result of the season's work, two new specimens have been

added to the flora of North America, and fifteen new records made for the county of Los Angeles.

A. DAVIDSON, Chairman.

GEOLOGICAL SECTION.

Our first section meeting was held in October in the auditorium of the Girls' Collegiate School, Adams and Figueroa streets. Prof. W. L. Watts, well known in mining and oil circles throughout the State, gave us a very entertaining and thoughtful talk on some of the geological conditions of Southern Mexico, illustrated with maps and photographs. Different phases of the life in that part of the world were also portrayed, and all was highly appreciated.

On November 26 Dr. Koebig, former city chemist, gave us a very interesting lecture on "Cement Deposits," at the State Normal School.

Prof. Spalding's "Cyclic Phenomena," in December, took the place of a section meeting for that month. Since the first of the year there has been much faulting along our geological structural lines, and much irregularity is apparent in the general formation, not caused by quakes and rock slidings, but by the enforced absence of the chairman of the section in Mexico on private business, and in Nevada under a commission from our Chamber of Commerce to report on the mining and general conditions of the territory tributary to the metropolis of California, Los Angeles city.

GEO. W. PARSONS, Chairman.

**Report of the Cash Receipts and Expenditures for the
SOUTHERN CALIFORNIA ACADEMY OF SCIENCES,
For the Year Ending June 5, 1907.**

Balance on hand June 25, 1906.....	\$ 28.62
Collections, dues from members	456.00
Donation from Mr. J. D. Hooker.....	120.00

Total Receipts	\$604.62
Total Disbursements	535.89

Balance cash on hand	\$ 68.73
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S. J. KEESE, Treasurer.

Los Angeles, Cal., June 5, 1907.

Flora of Clifton, Arizona

By A. Davidson, M.D.

Compositae.

- Hoffmeisteria pluriseta*, Gray. River canyons.
Eupatorium pauperculum, Gray. Shady rocks. Common.
Carminatia tenuiflora, D. C. Shady places above 4000 ft. alt.
Kuhnia rosmarinifolia, Vent. Blue River, Sept.
Brickellia atractyloides, Gray. Frequent.
Brickellia coulteri, Gray. Mesas; May.
Brickellia wrightii, Gray. Frequent; October.
Brickellia Baccaridea, Gray. Very common; October.
Brickellia wislizeni, Gray. Dry washes, Metcalf; October.
Brickellia betonicaefolia, Gray. Coronado mine, September.
Brickellia brachyphylla, Gray. Mesas; October.
Carpochaete bigelovia, Gray. Chase Creek, April.
Gymnosperma corybosum, D. C. River bottom; September.
Gutierrezia lucida, Greene. Common, September.
Grindelia arizonica, Gray. River bottom.
Heterotheca subaxillaris, Lam. Frequent.
Chrysopsis hispida, Nutt. Common.
Chrysopsis canescens, D. C. Blue River.
Aplopappus loricifolius, Gray. Common; September.
Eriocarpum gracilis, Greene. Common.
Bigelovia, graveolens, Gray. Sheldon.
Solidago bigelovii, Gray. Blue River; September.
Solidago californica, Nutt. Common.
Aphanostephus arizonicus, Gray. Gila and Frisco Rivers; April.
Townsendia fendleri, Gray. Gila River; May.
Aster spinosus, Benth. Common.
Aster commutatus, Gray. Canyons, Frisco River; April.
Aster canescens latifolius, Gray. Frequent.
Aster tanacetifolius, H. B. K. Common.
Erigeron subdecurrens, Schultz. Duncan.
Erigeron neo-mexicana, Gray. Metcalf.
Erigeron canadense L, Duncan.
Conyza coulteri tenuisecta, Gray. Above Metcalf.
Baccharis emoryi, Gran. Duncan.
Baccharis sarothroides, Gray. Metcalf; October.
Baccharis pteronoides, D. C. Coronado Mine; May.
Baccharis thesioides, B. B. K. Coronado Mine; October.
Baccharis viminea, D. C. Common.
Gnaphalium sprengelii, H. & A. Chase Creek.

- Gnaphalium leucocephalum**, Gray. Chase Chase.
Melampodium cinerum, Gray. Frequent.
Parthenium incanum, H. B. K. Above Metcalf.
Iva dealbata, Gray. Hachita, N. M.
Iva ambrosiaefolia, Gray. Generally distributed.
Ambrosia aptera, D. C. Duncan.
Zinnia anomala, Gray. Hachita, N. M.; September.
Zinnia grandiflora, Nutt. Common.
Zinnia pumila, Gray. Frequent
Sanvitalia aberti, Gray. Shady ground above 4000 ft. alt.
Eclipta alba, Hass. Duncan.
Gymnolomia multiflora hispida, Greene. Chase Creek.
Viguiera helianthoides, H. B. K. Blue River; September.
Encelia farinosa, Gray. Frequent.
Encelia frutescens, Gray. Dry banks.
Verbesina rothrockii, Rob. & G. Hachita, N. M.; Sept.
Verbesina encelioides, B. & H. Common.
Bidens bipinnata, L. Above Metcalf.
Heterospermum pinnatum, Gray. Garfield, Blue River.
Layia elegans, T. & G. Common.
Baileya multiradiata, H. & G. Very common.
Laphamia ambrosioefolia, Greene. In clefts of sandstone rock,
 just south of Clifton; September.
Eriophyllum lanosum, Gray. Clifton.
Bahia absinthifolia dealbata, Gray. LL.
Bahia chrysanthemoides, Gray. Dry washes.
Hymenothrix wislizeni, Gray. Rocks near Duncan.
Hymenothrix wrightii, Gray. Frisco River, Clifton.
Hymenopappus flavescens. Ward's Canyon.
Chenactis carphoclinia, Gray. Common.
Picradenia davidsoni, Greene. Common, on Frisco and Gila
 River sands. Type locality. April.
Gaillardia pulchella, Foug. Frequent.
Flaveria repanda, Lag. Duncan.
Pectis prostrata, Cav. Sheldon: September.
Pectis angustifolia, Torr. Common: September.
Pectis filipes, Gray. Metcalf; September.
Pectis longipes, Gray. Metcalf; May.
Artemesia ludoviciana, Nutt. Frequent.
Artemesia mexicana, Willd. Common.
Bebbia juncea, Greene. River canyons.
Senecio Neo-mexicanus, Gray. Common.
Senecio eremophilus, Richards. Tanner's Canyon: November.
Senecio douglasii, D. C. Common.
Senecio parryi, Gray. Metcalf and Blue Rivers: September.

Cnicus neo-mexicana, Gray. Metcalf; September.
Perezia wrightii, Gray. Longfellow.
Perezia nana, Gray. Ward's Canyon; May.
Trixis augustifolia, D. C. Chase Creek; October.
Stephanomeria runciata, Nutt. Common.
Stephanomeria thurberi, Gray. Blue River.
Microseris linearifolia, Gray. Common.
Malacothrix sonchoides, H. G. Common.
Malacoth. fendleri, Gray. Common.
Malacoth. glabrata, Gray. Common.
Calycoseris wrightii, Gray. Common.
Lactuca ludoviciana, D. C. Blue River.
Aster ercoides, L. Frequent.
Aster multiflorus, Ait. Duncan. Metcalf.

Porcupine, Grouse and Sparrow

While Dr. Hasse and I were botanizing in the Tehachapi Mountains in the first week of June, this year. We flushed a solitary grouse on the slopes of Mt. Tehachapi about 6000 feet altitude. Dr. Minney of the Pine Tree Mining Company informs me that one of the workmen shot two grouse near there last winter. This bird, probably the common grouse of the Sierra Nevadas, must be rare so far south, as I have never before seen it in my many wanderings in the San Bernardino Range. Near the mining camp Dr. Minney has frequently seen a lone porcupine, another rare mammal in this country. Stephens (Mammals of S. Cal.) reports its having been seen in the San Bernardino Mountains in 1903.

The common English sparrow has reached Lancaster on the Mohave Desert. We saw two pairs there last year. It may soon reach Los Angeles.

A. DAVIDSON.

PHYSICS OF THE SHOOTING STARS

J. F. Lanneau, Prof. Math. & Science, Wake Forest College, N.C.

Everyone is familiar with the suddenly bright, star-like objects which swiftly and silently dart here and there in the evening sky every few minutes. These transient and seemingly erratic meteors are popularly known as shooting stars.

In Ptolemy's *Almagest*—written in the second century of our era, the authoritative text on astronomy for fourteen hundred years, taught once even in Harvard and Yale—there was no mention whatever of shooting stars. They were held to be mere exhalations from the earth—of no concern to an astronomer. But found to be truly celestial bodies, their study has become in recent years a specialty with some astronomers.

By physics of a shooting star is meant such facts as its height above the earth, its distance from the observer, its mass or weight, and other seemingly unattainable knowledge concerning it.

It is proposed to show in outline how such knowledge may be gained.

Height, Distance, Velocity

Two observers—one say near Wake Forest and one thirty-five miles due south, near Selma—agree to watch the western sky every fair evening until nine o'clock. Many of the little meteors carefully noted by one of the watchers are not observed by the other.

One evening however, as subsequently shown by comparing records, they both note the same shooting star seen to pass from the point *s* to the point *s'*, Fig. 1.

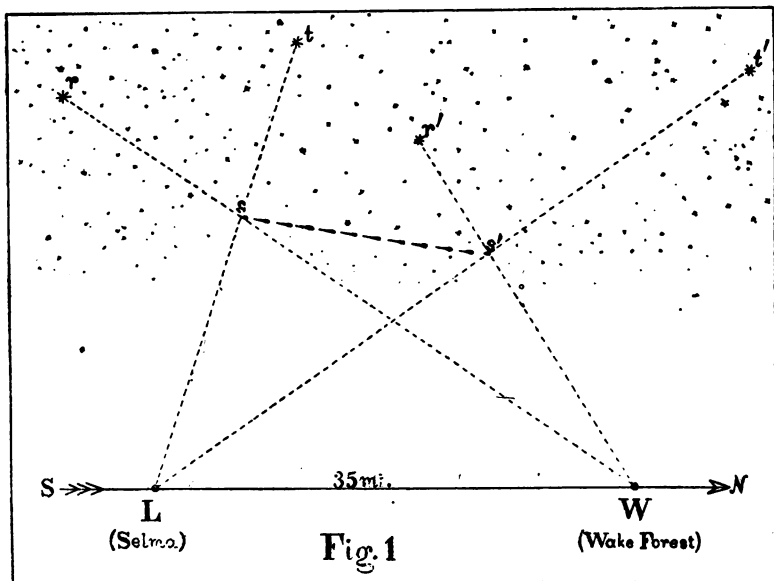
Each observer counts rapidly while it shoots from *s* to *s'*. At the same time he notices the particular fixed stars nearest in line with its appearance and disappearance at *s* and *s'*—the stars at *r* and *r'* as seen from *W*, and the stars *t* and *t'* as seen from *L*. This much quickly done, each looks at his watch to see the hour and minute of the occurrence. Then, by several repetitions of his rapid count, watch in hand, he finds the number of seconds in the transit from *s* to *s'*.

Their records, say, are :

—At L—		—At W—	
Count	23; Time, 5½ sec.	Count	26; Time, 6½ sec.
From	Castor, (star beyond <i>s</i>)	From	α Hydræ, (star beyond <i>s</i>)
To	Capella, (star beyond <i>s'</i>)	To	Procyon, (star beyond <i>s'</i>)
Date	May 1 '05, 8:30 o'clock p. m.	Date	May 1 '05, 8:29 o'clock p. m.

The two sets of notes agree substantially, as they should, in

the number of seconds of the shoot from s to s' and in the hour and minute of the observations. They differ, of course, as to the stars in the lines of sight from stations thirty-five miles apart. The averages of the time from s to s' and of the time



of observation, as noted, are taken as correct; 6 seconds as the time of transit and 8 hours 29 minutes 30 seconds as the time of observation.

These simple observations are sufficient. The rest is matter of calculation aided by data taken from the American Ephemeris, a government publication based on the work of the National Observatory at Washington.

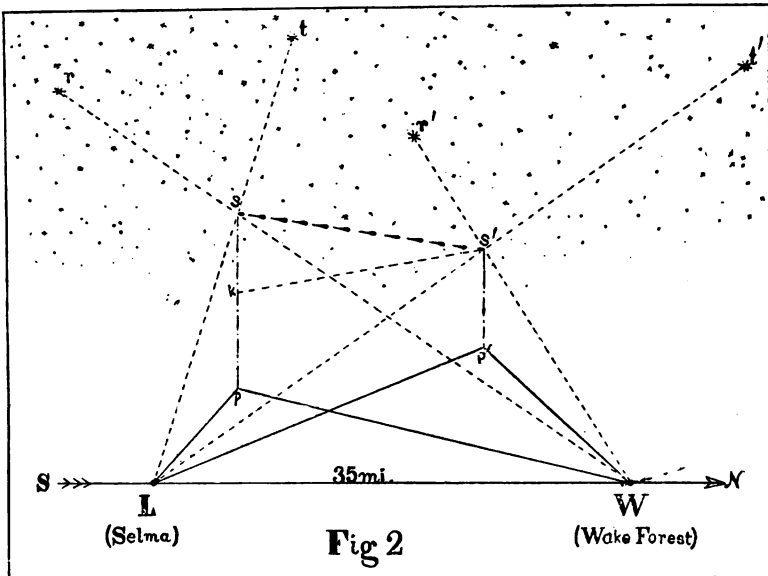
Skilful use of the data for Castor and Capella, α Hydræ and Procyon, gives the directions of those particular stars as seen from L and W at 29 minutes and 30 seconds past 8 o'clock on the evening of May 1; that is, the directions of s and s' from L, and their directions from W.

In Fig. 2, p and p' are points on the earth vertically under s and s' . The directions found by calculation as just stated, are: for s , its angles of elevation pLs and pWs , also its horizontal bearings, the angles pLs and pWs ; and for s' the like angles $p'Ws'$, $p'Ws'$, $p'LS$ and $p'WS$. Obviously, this gives all the angles of each of the three triangles which meet at p and of the three which meet at p' . And since one side, LW , is 35

miles, all the other sides in each of the six triangles can be calculated.

We thus find ps the shooting star's height when first seen, Ws its distance from W and Ls its distance from L ; also $p's'$ its height at the moment of extinction, and Ws' and Ls' its distances at that moment from W and L .

The line $s'k$ is drawn parallel to line $p'p$, omitted in the figure. Triangle $p'pL$ gives the length of $p'p$ and therefore of its equal $s'k$. Right triangle $s'ks$ gives length of ss' . This length was



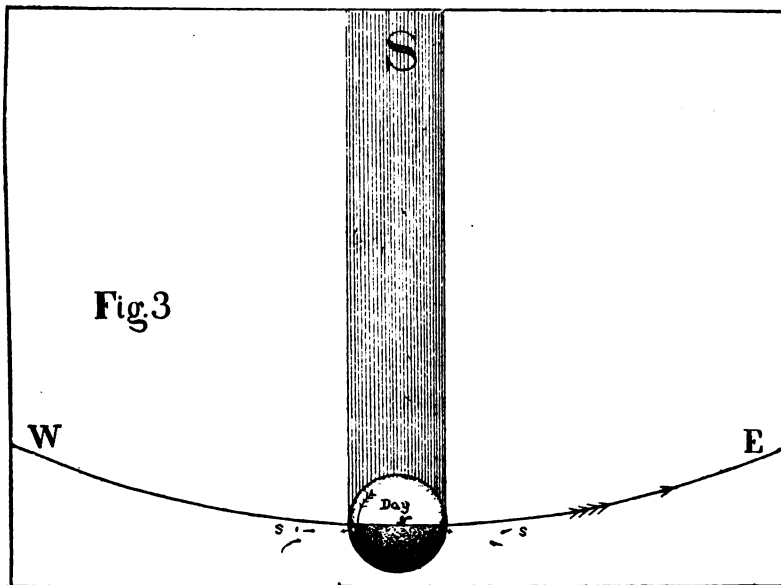
traversed in six seconds. One-sixth of it is the shooting star's velocity per second. Such observations and calculations show that usually a shooting star's height, when first visible is about 75 miles; and when it disappears, about 50 miles. Also, that its velocity ranges from 8 to 44 miles per second—indicating that its velocity through outer space, just before it entered our atmosphere, was about 26 miles per second. Its distance from the observer varies greatly, from 60 to 600 miles—possibly 770 miles.

The observed velocity is, of course, only relative to the earth. Its wide range, from 8 to 44 miles per second, is readily understood by considering Fig. 3.

In this figure, the earth is represented turning eastward about

its axis—N its north pole—and moving in its orbit eastward, the Sun being in the direction of S.

On observer at O has just passed into the evening shade. Relative to him, the earth's orbital motion, 18 miles per second, is **downward**. If he sees a nearly overhead shooting star it is overtaking the earth, and its velocity, relative to the earth, is $26 - 18 = 8$ miles per second. An observer at O' is soon to greet sun-rise. Relative to him, the earth is moving **upward** 18 miles per second. A shooting star above him is meeting the



earth, and its relative velocity is $26 + 18 = 44$ miles per second. To either observer, a shooting star crossing the earth's path will show more nearly the average velocity.

A notable shower of shooting stars occurred on the 24th, of November 1892. It continued for three hours after 8 o'clock in the evening.

That periodical star shower—the Bielids—will occur again this November—in the evening of some country. It may occur during our evening hours. If so, notice the slow motion of the “falling” stars. Should the reader be privileged to see the next Leonid star-shower, expected in the early morning hours of November 15, 1933, he will note the startling rapidity of the star-fall.

In general, the velocity of the evening shooting stars is less

than 26 miles per second, and that of morning shooting stars is greater.

Moreover, as the earth speeds on in its orbit its front is the sun-rise side and its rear is ever in the evening shade. We therefore see more shooting stars in the early morning than in the evening—just as in a walk or drive more people meet us than overtake us.

Mass or Weight

To find a shooting star's weight requires the help of an assistant observer at one of the stations. When preparing for the observations at W and L, Fig. 1, suppose an incandescent lamp of 16 candle-power was placed at an elevation above a high hill west of W, plainly visible to the assistant at W and distant from him just one half mile.

The assistant does one thing only. He compares the brightness of the lamp high up in the west with the brightness of each shooting star noted, and in each instance records his judgment as to the relative brightness of star and lamp. Of this he soon judges quickly and correctly, especially when the flitting star and the distant light are about equally bright. Even an unpractised eye decides readily which of two nearly equal lights is the brighter. Of hundreds asked by the writer which of the twin stars, Castor and Pollux, is the brighter, not one decided incorrectly.

Say that to the notes of Fig. 1 the assistant at W added: "brightness of shooting star and incandescent lamp just equal;" also, that the calculations of Fig. 2 proved that the shooting star's average distance from W was 60 miles. This data—distance of lamp, distance of star, their equal brightness—and established principles of Physics, will give the shooting star's mass or weight.

Since to make a one candle-power light requires 150 foot-pounds of work or energy per minute, the 16 candle-power light on the hill was produced by 16 times 150 ft.-lbs. of energy per minute, or by 1-10 of 16 times 150 ft.-lbs. of energy every 6 seconds; that is, it was made by using every 6 seconds 240 ft.-lbs. of energy.

The shooting star 60 miles off and shining 6 seconds, as observed, was just the brightness of the 16 candle-power light $\frac{1}{2}$ mile away.

The intensities of two such lights—lights equally bright at different distances—are as the squares of the distances. In this instance then, their intensities were as 60^2 to $(\frac{1}{2})^2$, or as 14400 to 1. That is, the energy which produced the shooting

star's brightness was 14400 times 240 ft.-lbs. = 3456000 ft.-lbs. of energy.

For a body in motion, the established relation between its weight expressed in pounds, its energy in foot-pounds and its velocity in feet per second is $W = 64 \cdot 1 \cdot 3 \frac{E}{V^2}$. So the weight

of our shooting star was $64 \cdot 1 \cdot 3 \frac{3456000}{(26 \times 5280)^2} = \frac{1}{84} \text{ lb.} = \frac{1}{5} \text{ oz.}$

Not infrequently a meteor weighing many pounds reaches the earth's surface—as claimed for the black stone enshrined in the Kaaba at Mecca. But the usual shooting star which is dissipated in the air, is a light body—in many instances not more than a grain in weight.

Causes of Sudden Brightness and Quick Extinction

When a moving body is checked, or stopped, its seemingly lost energy instantly reappears as heat.

The simple clapping of hands—repeated checking of motion—heats them. A piece of iron on an anvil hammered sufficiently, becomes red hot. Visitors to the Chicago exposition in 1893 recall the muscular Samoan who, astride a dry log, so vigorously rubbed the end of a stout stick back and forth along a shallow groove in the log that soon it was ablaze!

Mechanical energy checked, is converted into heat at the rate of 772 ft.-lbs. of energy to one heat unit. The heat which raises the temperature of a pound of water one degree Fahrenheit is taken as a unit of heat.

The air's resistance checked and soon stopped our shooting star's swift motion, converting its astonishing amount of energy, 3456000 ft.-lbs., into a correspondingly large quantity of heat, 4477 units. This much heat would make a half-gallon of ice-cold water boil—and boil away as steam! Its self-evolved heat raised the substance of the shooting star to incandescence—caused its sudden brightness. Did it melt and vaporize the matter of the little meteor? Let us see. Had its weight been 84 times greater—a full pound—and its substance solid platinum, one of the most refractory of metals, it would have been melted by only 49 units of heat—provided the temperature was as high as 3230 degrees Fahrenheit.

Experiment shows that when a body speeds through air 125 feet per second its temperature rises 1 degree. If its velocity is doubled, its temperature rises 4 degrees; if trebled, 9 degrees.

That is, the number of degrees rise of temperature is the square of the times the velocity contains 125 feet.

Allowing that our shooting star was one of the slowest, its velocity only 8 miles per second, its temperature was raised

$\left(\frac{8 \times 5280}{125}\right)^2 = 11419$ degrees; more than three times the temperature at which even platinum melts.

It seems therefore, that whatever the shooting star's substance it is quickly raised to glowing heat; that if solid it is soon melted and vaporized—the melted matter being swept off by the rush through the air, forming the luminous train until none is left, when comes its sudden extinction. Its cooled vapors and ashes mingle with the air, and the dust-like débris slowly settles to the earth's surface.

Number Daily

Simple means will serve to effect a fairly accurate count of the number of shooting stars visible at a given place during a definite period.

At a selected station in an open space erect a pole 6 feet high.

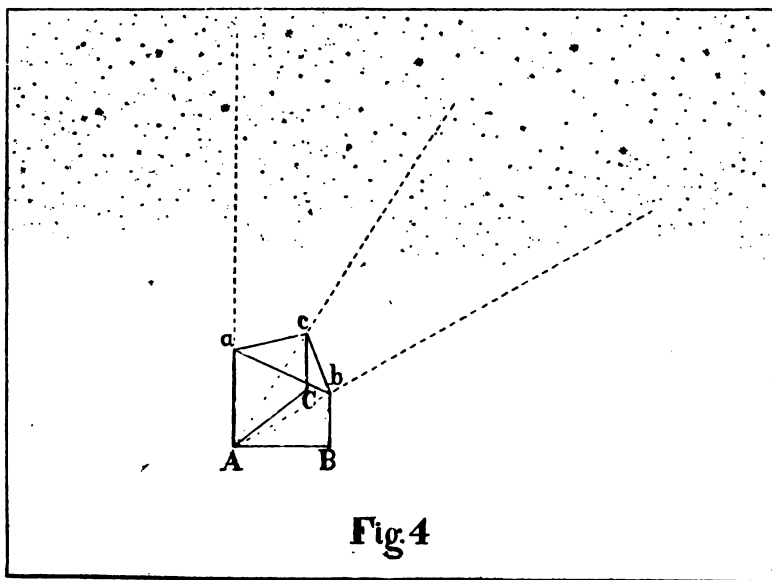


Fig 4

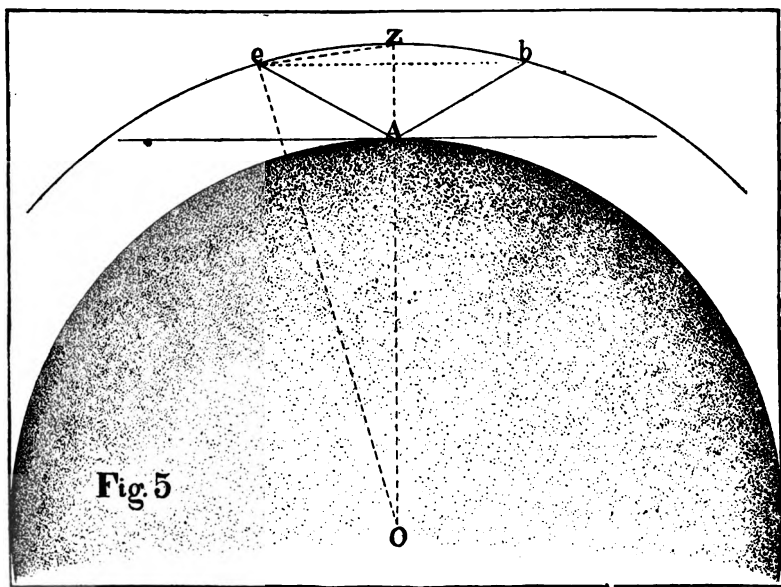
Trace from it on the ground two lines diverging 45 degrees—half a right angle. On each line, at a distance of 6 feet from

the pole, drive a stake. Connect these stakes by a stout string $3\frac{1}{2}$ feet above the ground, and from each stake, at that height, stretch a string to the top of the pole.

In Fig. 4, A is the station, Aa the pole. At distances and heights stated, the stakes Bb and Cc are connected by string bc; and strings stretch from a to b and from a to c.

An observer, full length on the ground, his head at A and feet toward the stakes, scanning at his ease that part of the sky which appears within the triangle of strings, abc, will see just one-eighth of all the clear sky above the hazy zone around the horizon 30 degrees high. Eight observers so placed about A, each watching only the part of the sky marked off by his triangle of strings, would see all the shooting stars that appear in the clear sky while they watch.

On a fair evening it is found that each such observer sees a shooting star about every four minutes, or an average of 16 per hour. Eight observers see 128 shooting stars per hour.



Thus through the upper air surface—all of it that is above the 30 degree belt around the horizon—there must enter daily 24 times 128 shooting stars, or 3072 per day.

Fig. 5 will serve to show the full significance of this result—

that 3072 shooting stars enter daily the limited air space which our eight observers watch only a few hours.

In this figure the earth's radius $OA = 3959$ miles. The arc eb indicates the level of air surface in which shooting stars first appear. Let us call it the surface of apparition. As previously shown, the height $Az = 75$ miles. Our eight observers, flat on the ground, have their heads about the pole at A . Their lowest line of sight Ab , or Ae , is elevated 30 degrees. Therefore angle $zAe = 60$ degrees. During their vigils they see all shooting stars that enter the zone of apparition capping the funnel shaped space eAb .

We must compute the area of that zone. The upper edge or rim of the funnel is a circle whose diameter is eb . The zone watched is that part of the air surface cut off by a horizontal plane through eb . It is called a zone of one base, and its area equals a circle whose radius is the distance ze . We must find that distance. In triangle eOA , angle at A being known, also the sides OA and Oe , we find eOA , or $eOz = 18^\circ 47' 47''$. In triangle eOz , knowing angle eOz and sides Oc and Oz , we find $ze = 126\frac{3}{4}$ miles. A circle of this radius contains 50462 square miles. The watched zone of apparition then covers 50462 square miles.

How many times larger than that zone is the entire surface of apparition which envelopes the earth at a height of 75 miles? Its radius $Oz = 3959 + 75 = 4034$ miles. Its area therefore, is over 204 million square miles. This is fully 4052 times 50462 square miles. That is, the area of the entire surface of apparition is 4052 times the area of the zone through which, as we have seen, enter daily 3072 shooting stars. Therefore, into the entire atmosphere enveloping the world there enter daily at last 4052 times 3072 shooting stars—in round numbers, $12\frac{1}{2}$ million.

But had our eight observers held their vigils in the early morning before dawn, they would have counted more than double as many shooting stars per hour—indicating some 28 million per day.

Average the evening and the morning counts, and we find that the number of shooting stars which plunge into our atmosphere daily is fully 20 million.

Distribution

The earth with its air envelope to a height of 75 miles, or simply the whole surface of apparition, is a globe whose radius is 4034 miles. The space through which it speeds daily $18\frac{1}{2}$ miles per second, is more than $1\frac{1}{2}$ million miles long. Its cross

section, a circle whose radius = 4034 miles, has an area of more than 50 million square miles. This long cylindrical space through which we sweep daily contains more than $1\frac{1}{2}$ million $\times$ 50 million = 75 million million cubic miles. More accurately it is over 80 million million cubic miles. Since in this space we touch 20 million little masses, to each one there is a space of 4 million cubic miles. Each little mass, a shooting star when it enters our air, has around it 4 million cubic miles of free space. In general, it is at the center of a cube of space each edge of which is about 160 miles long. From center to center of such spaces is 160 miles.

We thus find that throughout the space traversed by our earth in its journey around the Sun embryo shooting stars, while always in motion, are distributed at intervals of about 160 miles.

Origin

Comets move in planes which all pass through the Sun, but cut each other at all angles. They therefore move through space in all conceivable directions. When nearing the Sun their volatile matter is driven off in streaming tails of great length, and much of it, disrupted and scattered, lost to the parent body, pursues at intervals approximately the same general path as formerly.

Not a few comets pass close by the earth's orbit, crossing it at different points and at different angles. Some of these, as in the well known case of Biela's comet, have been shattered by disintegrating forces. They have ceased to appear as comets. In their stead, when due, are showers of shooting stars—the débris of the disrupted comets. That part of the passing débris swarm which enters our atmosphere is checked by the air's resistance, as was shown, and falls to the earth. The rest passes by until, on another round, it again grazes us, and is again diminished by another star-shower.

This doubtless is the origin of shooting stars which come in showers—like the Bielids every thirteen years, and the Leonids at intervals of thirty three and a third years—also of stragglers which, like the August Perseids, come annually.

Possibly, in the débris of shattered and shattering comets we have the origin of all shooting stars.

Effects

We have seen that a shooting star weighing 1-84 of a pound

is dissipated by its self-evolved heat, that its vapors mingle with the air and its ashes settle to the earth.

Our world is thereby made 1-84 of a pound heavier!

Take this as an average, and the 20 million shooting stars per day make the earth 125 tons heavier. This daily addition amounts to 45000 tons yearly.

How much will this increase the earth's size? Allow that all this meteoric matter, 45000 tons annually, finally settles to the earth's surface in a continuous layer of uniform depth; and that, like some common earth, a cubic foot of it weighs 80 pounds. Having the earth's radius, 3959 miles, we find its surface area is more than 5000 million million square feet. If covered with meteoric matter one inch deep, the weight on each square foot would be 1-12 of 80 pounds = 6 2-3 pounds. On the entire surface there would rest a weight of 33 1-3 thousand million pounds, or 16 2-3 million million tons. This is 370 million times 45000 tons, the yearly deposit.

That is, in 370 million years this accumulating shooting star dust will form on the earth's surface a layer one inch deep!

That 45000 tons of matter added to our earth every year for 370 million years would raise the level of its surface only one inch, may well expand our conception of the vastness of our earth.

We have seen, too, that one shooting star evolved 4477 units of heat. At that rate, 20 million daily bring us over 89½ thousand million heat units, and in a year, over 32 million million units of heat.

Uniformly distributed, how much heat is this to each of the 5000 million million square feet of the earth's surface?

Evidently, to each square foot only $\frac{32}{5000} = \frac{6\frac{2}{3}}{1000}$ of a heat unit.

Contrast this with the heat we receive from the Sun.

Skillful experiments prove that the Sun sends to each square foot of the earth's surface on which it shines an average of 11

heat units per minute, or $\frac{11}{60} = \frac{110}{600}$ of a unit per second, or

$\frac{110}{6000} = \frac{18\frac{1}{3}}{1000}$ of a heat unit in 1-10 of a second. That is, we

receive from the Sun in 1-10 of a second nearly three times as much heat as is brought to us by myriads of intensely heated shooting stars in an entire year! The contrast serves to quicken our realization of the Sun's dominance in the support of terrestrial life by its constant, incomparable yield of heat.

7:1



BULLETIN

OF THE

✓
**Southern California Academy
of Sciences**



LOS ANGELES, CALIFORNIA, U. S. A.

JANUARY, 1908

BULLETIN
OF THE
Southern California Academy of Sciences

Committee on Publication:

Melville Dozier

A. Davidson, C. M., M. D.

Wm. H. Knight

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Editorial Notes

Los Angeles is becoming a recognized center of science, literature, art, music, and learning in every realm of human thought, not alone for the great Southwest of which it is the metropolis, but, in consequence of the annual tide of tourist travel which sets in this direction from all parts of the country and from many other lands, it is becoming one of the world's great centers of culture and education.

Among the institutions which have given this city an enviable reputation is the Southern California Academy of Sciences, which has for its special object the investigation of natural phenomena and the dissemination of scientific truths.

With the present number of the Bulletin the Academy of Sciences inaugurates an important change in the publication, making it semi-annual, adding to the variety and scope of its contributions, and embracing more fully than in the past, articles relating to the several departments of science. There has been an encouraging increase in membership lately, and it is hoped by the Publication Committee that enough additional members may be secured to warrant the issuance of a quarterly Bulletin, thus enabling us to keep fully abreast of the scientific thought and progress of the age.

The work of the Academy is being conducted with great vigor. Interesting and instructive lectures, popularizing some branch of scientific inquiry, are given to intelligent and appreciative audiences at Symphony Hall, on the first Monday of each month. All of the other Monday evenings of the month are occupied by Academic Sections where subjects requiring more technical treatment are discussed by specialists.

The Astronomical Section has an equatorial telescope with a four and one-half-inch objective, capable of showing the discs of the planets, separating many beautiful double stars, and resolving numerous star-clusters. Current astronomical events are reported and elucidated at these meetings.

Geologists and mining engineers familiar with the geological formations of the great Southwest and its rich and varied mineral products, have made the evenings devoted to the Geological Section particularly attractive. Charts of the structure and workings of famous mines, theories of vein formations, the part that chemical action is playing in aggregating and disseminating the precious metals, and theories of the origin and occurrence of our immense fields of crude oil in Southern California, have proved profitable subjects for discussion at these meetings.

The Biological Section has done some of the most useful work of the Academy. Its wide range of subjects, the ability with which they have been discussed, the excellence of the illustrations used, the beautiful slides which have been prepared, and the free use of microscopes of great magnifying power, have added greatly to the charm of these meetings.

W. H. K.

Astronomer in an Iron Tank.

While Prof. David Todd, the astronomer, was on the top of the Andes last summer, nearly three miles above sea level, observing Mars and taking his marvellous photographs of its canals, he worked for a time in an iron tank about six feet square, into which the air was pumped until the pressure within was the same as that at the level at the sea. The compartment was lighted by electricity and was connected with the outer world by telephone. This device enabled the professor to do work which would otherwise have been impossible at that great elevation.



Colias Eurytheme—Boisduval
Southern California
Males—Lower Three Specimens
Females—Upper Two Specimens

Environment—Its Effect on Butterfly Forms

By J. R. Haskin.

The study of Butterflies at first glance seems to the unthinking majority to be a very trivial pursuit. As a science, however, it presents many points of interest which increase rapidly as one goes more and more deeply into the subject. To the beginner, the raw amateur, it sometimes seems as if distinctions were too finely drawn, and certain forms were differentiated into far too many species. But as one progresses in the study, one soon realizes that he is face to face with Darwin's theory of the evolution of species and that the changes, great and small, which he gradually becomes able to distinguish, are due to environment.

The genus **Colias** illustrates very nicely these changes which the influence of climate and food produce in the size and coloration of butterflies. A well-known authority specifies eleven species that are fairly well defined, but he, also, states that there are a number of other named species as well as numerous varieties from the Central and Western States. These numerous species differ very slightly from each other in many cases, but if a sufficient number of specimens from each locality be grouped and compared with each other, the difference can readily be seen.

Generally speaking a warm equable temperature and abundant food produces the richest coloring and largest specimens. **Colias Eurytheme** illustrates this particularly well on account of its being a triple-brooded southern and western species. Those specimens taken late in the Fall and early in the Spring, (Form **Ariadne**) show the effects of a meagre diet and exposure to the nipping cold night temperatures by their small size and the absence of the rich coloring of the Summer form, shown in the accompanying illustration. It seems, in fact, hardly believable that these widely different forms are of identically the same species. **Ariadne** is small and insignificant looking, pale yellow in coloring, with only an occasional touch of orange. The typical Summer form, on the contrary,

is in general, highly decorated with orange which often shows a rose madder tint when held in certain lights.

The reader will note that we say in general when referring to *Eurytheme*'s coloring. This is necessary for the reason that the female of ***Eurytheme*** is strongly polymorphic, that is to say, it has various forms. While the markings of the female are rich and full in all cases, the ground color varies from the tints described above to plain yellow and even whitish. This is another curious phase of the subject which is still under investigation, and which further complicates the study. It may readily be seen that when one species is subject to such changes it is necessary to know whence it came in order fully to identify and classify it. An amusing example of this occurred recently when a collector now connected with one of the large Eastern museums sent a specimen from a Southern postoffice to one of our best known authorities with a request that it be identified. It was returned labeled, *C. Eurytheme*, and was immediately forwarded again, from an Eastern address. This time it was returned labelled, *C. Philodice*.

Now, the standard types of the two species are decidedly different, but certain specimens of the yellow and whitish Southern females closely approach the female of *Philodice* in appearance, so that by falsely locating the place of capture, even the most experienced collector can be misled. As a general rule, however, the specimens from one locality follow a certain type of marking and coloring that was very certainly produced by the physical qualities of the surroundings. It is this fact which makes the study of our butterflies so interesting and which allows of so much careful study and research without exhausting the subject.

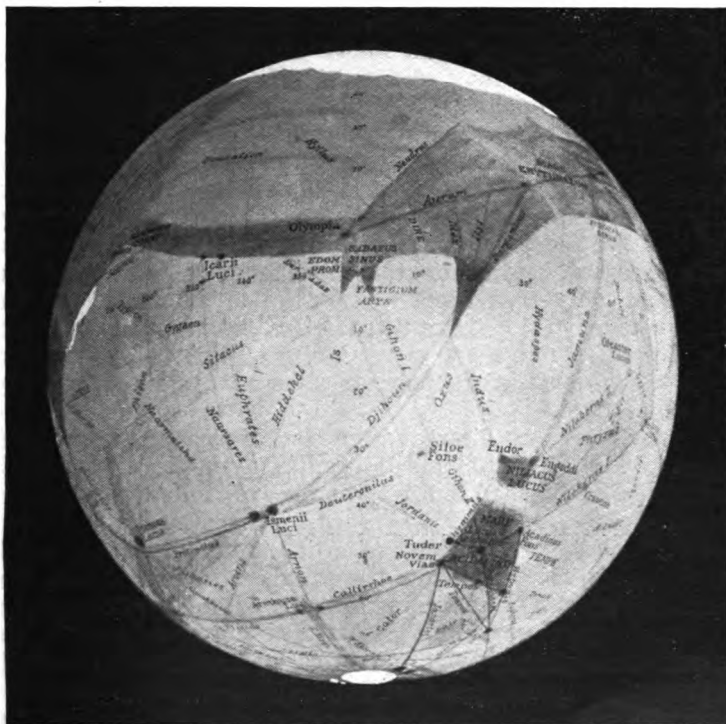
Captain Collins in Europe.

The secretary of the Astronomical section, Capt. Holdridge O. Collins, went abroad in October, accompanied by his daughter, Miss Constance, and while in Vienna visited the Imperial Observatory, where he met the distinguished director, Dr. Edmund Weiss, with whom he had a pleasant interview. A description of the buildings, instruments, library and working force of astronomers will be furnished to the Bulletin later.

Is Mars an Inhabited World?

By Wm. H. Knight.

At the last "favorable" opposition of Mars, which occurred in the months of June and July 1907, that planet approached within 38,000,000 miles of the earth, and shone the most resplendent object in the nocturnal heavens. It was at



Reproduction by permission of a fine drawing from a photograph of the planet Mars, taken at the Lowell Observatory, Flagstaff, Ariz., during the "favorable opposition" of 1907, under the direction of Dr. Percival Lowell.

a similar opposition in August, 1877, that Asaph Hall discovered the two minute satellites of Mars, and Schiaparelli first discerned the so-called canals on its surface. But even the existence of these lines was doubted by less sharp-sighted astronomers till, in the favorable opposition of 1892, more powerful instruments confirmed Schiaparelli's observations. The

geometrical regularity of the lines pointed to an intelligent origin, and the probability that Mars is inhabited was a frequent theme of discussion, both by astronomers and laymen.

The astronomer who has been foremost in supporting this view during the present decade is Percival Lowell, whose exceptional facilities for observation at Flagstaff, give his opinion great weight. The high altitude of his observatory—7,000 feet; its low southern latitude, bringing the planet many degrees nearer the zenith than Yerkes, Harvard, Greenwich and other large observatories; the powerful refractor (24-inch objective) with which he is equipped; the freedom from atmospheric disturbances on his elevated plateau, giving him unusually "good seeing;" and above all, the keen eyesight of Professor Lowell—almost a special gift; all these combined advantages have enabled him to study the planet under ideal conditions, and thus to reach just conclusions.

He believes that the geometrical figures he has observed on the surface of the planet were designed by engineers of no mean order of intelligence. They are not myths, but actually exist and, are clearly defined and readily mapped at certain Martian seasons, become dim and in some places fading out at a later stage, only to distinctly reappear at the return of the former season. They are not geological cracks in the crust of Mars, for the chances are more than a million to one against chance cracks arranging themselves into a system so orderly and symmetrical.

In order to secure a still better station for the observation of Mars while in astronomical proximity to the earth, Prof. David Todd established himself at a high altitude in the Andes, where the planet was nearly overhead, and succeeded in taking some 7000 photographs, many of which are so clear and excellent that they not only show the canals with remarkable distinctness, but even the doubling of many of the canal-like lines. The latter is a phenomenon hitherto observed only with the eye, and these photographs forever set at rest all cavil regarding the existence of these enigmatical lines. Thus does the beautiful art of photography supplement and confirm the patient, keen-eyed observations of the skillful astronomer.

Nature of the Canals.

Conceding, then, the existence and the artificial origin of these canals, the question arises, what is their nature; how are they produced; what purpose do they subserve? But first, let us consider one of the most serious objections which have been raised by astronomical writers against the habitability of Mars, namely, its assumed low temperature. The earth is

only two-thirds of the distance of Mars from the sun, which fact would imply, under similar surface conditions, a temperature so low that the higher forms of life here could not survive on that planet.

But Mr. Lowell points out modifying conditions on both planets. The earth, he avers, reflects off into space, a large percentage of the heat it receives from the sun, while the surface of Mars is such that it absorbs a much greater proportion of the sun's heat than does the earth. Now the average temperature of the earth's surface is 60 degrees F. This heat is derived from the sun and does not seem to be any more than we need for the best development of life as we know it. Yet life is abundant in regions where the temperature is higher, and also where it is much lower than this average.

For the reason named, and for the additional reason that no dense clouds intercept the sun's rays, Mr. Lowell estimates the mean temperature of Mars at 48 degrees—only 12 degrees less than the earth's, and concludes that this temperature would not be incompatible with the development and support of a high order of life.

Agility of the Martian.

Now let us take account of certain advantages possessed by the Martian inhabitant. Mars has a diameter of only 4200 miles as compared with the earth's 8000 and the mass of the former is only one-ninth that of the latter, hence an object weighing 100 pounds on the earth would weigh only 38 pounds on the surface of Mars. If their people correspond with ours in size, they can move with great agility and skim over the ground with the ease of wild animals. Then what great tasks of physical labor they can perform, what great masses of soil, (also of low specific gravity,) they can displace without fatigue. Tasks that would be deemed Herculean here, might be readily performed under those favoring Martian conditions.

But Mars has, from our point of view, a serious drawback—its atmosphere being much rarer than that which we breathe. Owing to the great mass of the earth and an enveloping atmosphere more than 100 miles deep, the latter presses with a weight of 15 pounds upon every square inch of surface. The Martians, however, would regard this as a great handicap, but as life here has been adjusted to this density and pressure, we may presume that the types of Martian life have conformed to the peculiar conditions existing there.

Another apparent drawback on the planet Mars is an absence of moisture-laden clouds, and the consequent lack of rain, especially in the central zones. Results; the general surface of

Mars presents the aspect of a parched desert, where life, without an artificial supply of water, could not exist. But, as in our own cloudless skies, the air contains large stores of invisible vapor, so it is evident that the same conditions prevail in the clear Martian skies, for when the Martian polar regions are turned away from the sun in the Martian winter, there is an extensive precipitation of snow, known to us as the polar snow cap, and as the season slowly changes to spring and summer, (the Martian year is nearly twice the length of the earth year,) the polar snow cap is gradually melted, and a dark belt, presumably consisting of water, is formed around the white, receding snow cap.

Whether this is an artificial basin for the retention of the water till it can be utilized, we have no means of knowing, but this we do know, that in their season, dark straight lines extend at various angles from this polar belt towards the equator, intersecting other lines similarly projected from the opposite pole, their meeting places forming apparent oases or basins.

Belts of Verdure.

Now these lines, in order to be visible in our most powerful telescopes, must be at least five miles in width, but are assumed to be from three to five times that breadth. Of course it is not to be supposed that there are any artificial water courses of that width. Such a hypothesis is neither reasonable nor called for. But suppose that each main canal, possibly of but a few feet in width, with its system of small lateral branches, were employed to irrigate a belt of territory 20 to 30 miles in width, then in its season there would spring up a mass of dark green vegetation which would form a marked contrast to the yellow, unirrigated desert adjacent to it, and that contrast would become strikingly apparent to terrestrial observers with powerful glasses.

Thus we see, at a distance of 40,000,000 miles, certain dark lines, which mysteriously appear, coincident with the receding snow caps, and as the season advances to the harvest period of their year, the lines become dim and some of them fade out entirely. For these belts of dark, luxuriant vegetation, having ripened, have probably changed to the tawney color of our California fields and hills in summer and autumn. So the Martian astronomer, looking down upon the State of California, will in the winter and spring months, see a belt of vivid green, 150 miles in width and 800 miles in length, but this will change to a saffron hue during the last half of the year, greatly to the mystification of the Martians.

What are the Martians raising in these long bands of ver-

ture, with which nearly the entire surface of the planet is reticulated? Is it fruit, cereals, vegetables, or some melon-like food of rapid and luxurious growth? What machinery does the Martian use in cultivating the soil, in gathering his harvest, in hauling it to the storehouse and to the market? Is he gregarious, does he dwell in cities, has he developed electric light and power, do his bankers refuse specie payments and resort to clearinghouse certificates?

We must wait for Mr. Hooker's gigantic 100-inch eye, which will be peering into Martian and other mysteries when the next favorable opposition occurs in 1924, before we can satisfy our scientific craving for more particulars, and perhaps even that mighty optical aid will be unequal to the emergency, for Mars lies across an appalling abyss of space, too fathomless for human genius to bridge in the present stage of scientific achievement. We can only get imperfect glimpse, now and then, but these supply data sufficient for reason and imagination to construct a hypothesis, perhaps a substantial theory, of life on a brother planet, traveling, like the earth, in a mighty orbit round the sun.

Astronomical Paradox.

Here is a little feathery comet, so attenuated that it does not dim the lustre of the smallest stars when interposed between them and the eye; so inconsiderable in mass that it has eluded the attempt of any mathematician to weigh it; so that today no astronomer can tell whether the mass of Encke's Comet is to be computed by tens, hundreds, thousands or millions of tons, yet this seemingly almost imponderable member of our solar system, swinging in an ellipse reaching from Mercury to Jupiter, has been successfully employed in weighing the masses of those and the intervening planets.

Diatoms

By Miss Sarah P. Monks.

Diatoms are organisms that have characteristics of both plants and animals. Unlike other plants they have the power of voluntary motion, and, unlike most animals, they possess chlorophyll. They are microscopic.

Zoologists look at them askance and botanists do not want them, but they are the pets of the microscopist, and well they

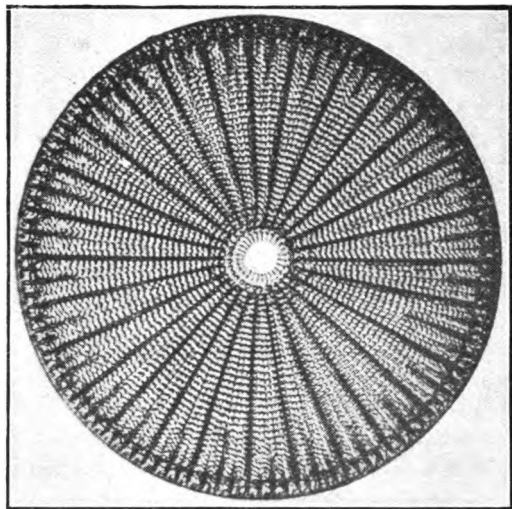


Fig. 1. *Arachnoidiscus* Mag. 300 Diam.
Micro Photograph by S. J. Keese

deserve this honor, for they are among the most exquisitely beautiful objects of the world.

They, unlike plants, have a silica shell composed of two valves, one fitting over the other like the lid of a pill box. These glassy valves are decorated with knobs, points and striæ, arranged in the most varied and delicate tracery. Sometimes under a low micro power, diatoms appear changeable, blue, green and various colors, because their tiny projections break the white light into its rainbow tints.

Diatoms are at present, classed as brown algæ, or sea weeds, on account of the dark brown pigment under their siliceous shell.

An interesting fact in regard to color was noticed by the Russian diatomologist, C. Mereschowsky, among the recent

diatoms of San Pedro. It was a species of diatom without color. It moved, acted and lived like a diatom, was a navicula,

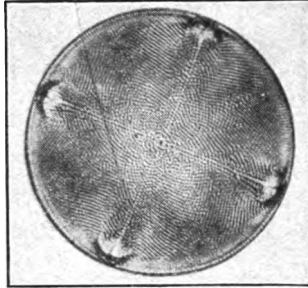


Fig. 2. Aulocodiscus, Mag. 200 Diam.
Micro Photograph by S. J. Keese

but had no brown pigment, no chloraptyll and sailed as a phantom among its fellows.

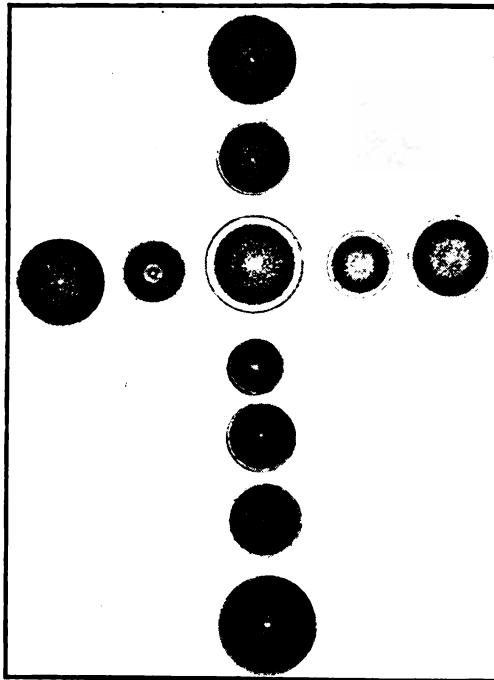


Fig. 3. Mag. 200 Diam.
Micro Photograph by S. J. Keese

M. Mereschowsky explained it thus: Living among the waste of the fish cannery, surrounded by an abundance of nutrient material—a sort of predigested breakfast food—this spectre of a diatom, not using its chloroptyll to manufacture its dinner, had lost the chloroptyll just as do the parasites among its kinsmen of the higher plants.

Diatoms vary indefinitely in shape. Some are round, others oval, squarish, triangular, elliptical, rod-like, or boat-shaped.

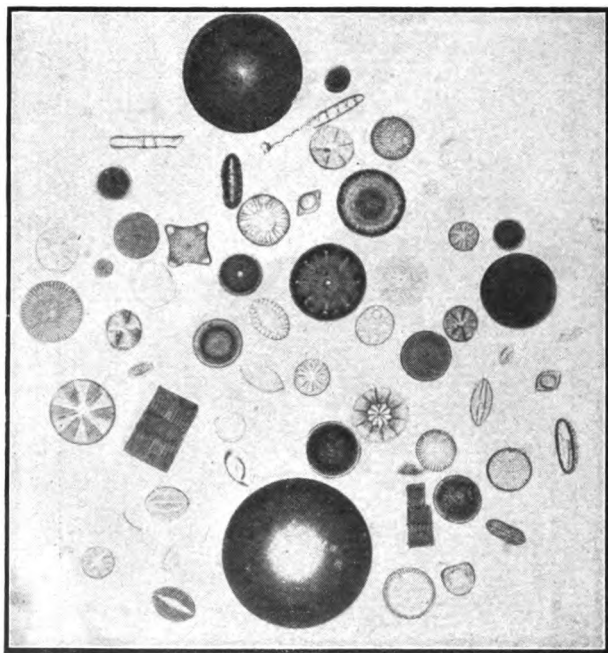


Fig. 4

Micro Photograph by S. J. Keese

One kind, *Isthmia*, very abundant on Pacific algæ, looks like a fat little money wallet, with a decorated strap buckled around to keep in its valuable contents. Salt water has more of the round, or roundish, kind and the long forms are more common in the fresh water. Figure 1, *Arachnoidiscus*, and Figure 2, *Aulocodiscus*, are round fossil forms from Redondo Beach, and they show something of the pattern and arrangement of projections. Figure 3 is an artificial arrangement of eleven. This kind breaks up the white light and under a low power objective, with the slightest motion, change color and glow like the slumbering hues and fire of jewels.

Figure 4 gives an idea of the variety of size and form of diatoms.

Diatoms are found singly or in colonies; free or attached; in hot or cold, fresh or salt water, recent or fossil, all over the world. Their motion is deliberate, in marked contrast with the irritable impatience of the Infusoria, which are their pond companions. One boat-shaped diatom called *Navicula* (of which there are two or three hundred species), is so abundant in all fresh water pools and ponds that nearly every microscopic mount shows a quantity of specimens and often several species.

These fairy brown fleets go moving across the field, sailless and rudderless, with a steady and gracefully easy motion. If perchance one meets with an obstruction, a bit of algæ, fibre of wood, or grain of earth, it bumps against it obstinately several times, then, convinced that its Northwest passage is blocked, it backs off and sails backward with equally deliberate dignity.

One odd species is called *Bacillaria paradoxa*. Its motion is most peculiar. This *Bacillaria* is composed of numerous rod-like pieces that can move upon each other, and it has the power of attaching itself to objects. Slowly across the field may be seen extending a jointed rod, its parts sliding past each other like a sliding ruler, till it attains its full length. Then the pieces slide backward, and, an arch, or zig-zag figure, or pontoon bridge is formed, the arrangement varying constantly with the ceaseless motion, till one is weary of watching. This peculiar species was abundant on Flower street, back of the State Normal School, before its ocean was drained and dried up for the good of the public.

The siliceous shells of diatoms are practically indestructible, and consequently they are an important item in world building. They are found in all geological strata as far back as the Devonian, and probably, much of the amorphous silica of the Silurian Age was at one time diatom shells. The fossil deposits are called diatomaceous earth.

Abundance of Diatoms.

These plants must have existed formerly in inconceivable numbers, for their remains form extensive beds of miles in extent in almost every country of the world.

The earth is abundant in California, and all states of recent geologic formation. "The city of Richmond, Va., is built on such a deposit, from two to eighty feet thick and several miles in extent." The city of Los Angeles has its share. There is a large area of this earth under the court house, another

at Second street and Bunker Hill avenue, another on Flower street, between Second and Fourth streets. In fact, there is scarcely an outerop, or a street cutting, in this city, that does not show some diatomaceous earth. The forms, however, of Los Angeles diatoms are not rare or remarkable. A large *Coscinodiscus* is extremely common.

The most extensive deposits in this locality is at Redondo Beach, about two miles from the city. Here, the entire bluff, about eighty feet high, and at least a quarter of a mile on the sea front, is composed of diatomaceous earth. As a similar deposit crops out five miles back from the sea in all probability they are continuous. Here the earth is of all conditionss and colors, soft, friable, in loose, thin layers; white, compact yellows, brown almost black. Like all the Coast bluffs, this place shows a surface of pinnacles, abrupt fronts, huge masses that have loosened and slid part way down and debris of all sizes at the base, but all here is of unmixed diatomaceous earth. Throughout this deposit there are flinty masses looking like petrified wood, which are supposed to be metamorphic diatom remains. It is called Diatomite. Specimens from Redondo have been distributed all over the world, and the locality is famous for richness in forms and number of specimens. Unlike chalk or clay, which it somewhat resembles, this earth is of extremely light weight.

The compact varieties float. At Redondo sometimes rounded pieces from the size of a marble to lumps a foot across, are strewn on the beach for a mile or more, where they have been washed ashore after floating and being rolled about by the waves. It is possible that the famous "floating find" of a number of years ago that was caught by fishermen off Santa Monica, was a bit of flotsam from the Redondo quarry. This piece was unique in number of species, and is one of the most famous lumps of the world. Its resting place before it began its voyage is unknown and regrettable, and is as fondly sought as a "lost mine."

Their Beauty Under the Microscope.

Diatoms have been used for a long time as "tests" of the power of objectives, because of the variety and symmetry of their designs and the great range of size.

One cannot consider diatoms without admiring the skill of micropists, who mount them; and it is a question of which excites the most admiration, the marvelous beauty of these plants, or the rare dexterity of the scientists. Indeed, the compositions of E. Thum. of Leipsic, are so surprisingly wonderful that they are called the "Oh my!" slides. The diatoms

are made into what is called "Type plates" where from 100 to 150 forms are arranged in symmetrical rows in a square, or they are made into concentric order or fancy designs of vases, fountains, of bouquets of flowers, all well within the scope of a one one-half inch objective. In fact, the whole figure is so small that, to the naked eye, it appears as a mere blun on the cover glass. And the deft way it is done adds to one's admiration. The earth is cleaned from fragments and sponge specules, and the different species sorted out under a microscope, all requiring great care and delicacy of touch. Then the diatoms are picked up, one by one, and put in their places in Canada balsam on the slide, then covered and laid away to dry. The lifting and placing is done by an instrument called the mechanical finger, which is made to move up and down from side to side by means of screws. But the funny thing about it is that the tip of this finger is made of a cat's whisker. Nothing has been found to be such a good diatom lifter as pussy's whisker.

When one is bitten by the diatom craze, the only hope is a microscope, and long delightful tramps with dip net and bottles, or hammer and basket for possible forms.

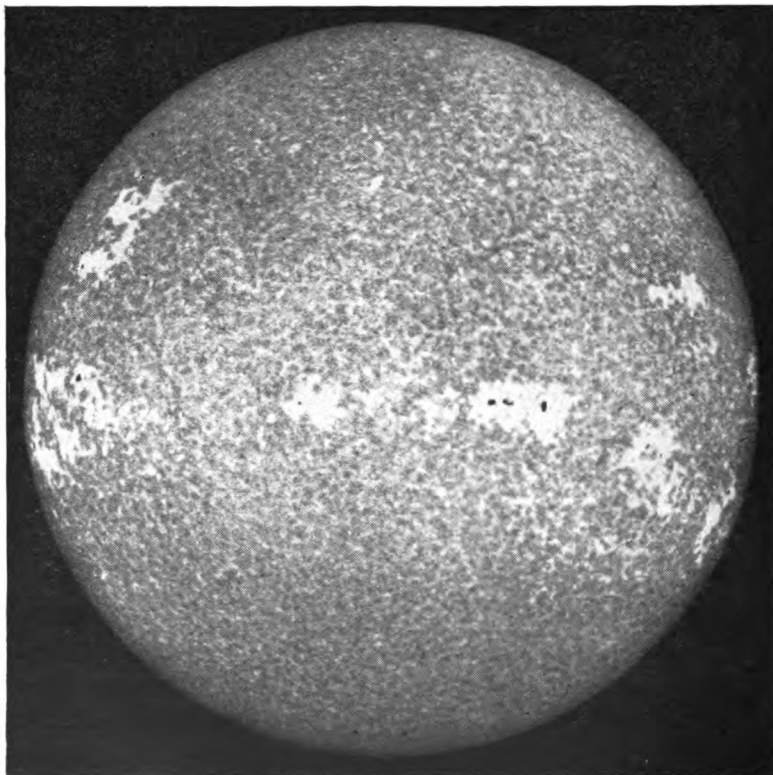
Each pool and brook is a treasure land, or water, and the sun-baked street or railroad cuttings become wondrous mines; and His Majesty who delights in idle hands, will have an uncomfortable quarter of an hour when the evening or holiday brings time for a micro hunt among the treasures collected from the pools or the great white earth deposits.

Celestial Measures.

In the beginning the number of days in a year was assumed to be 360, and it was observed that the sun traverses one-360th of the celestial circle each day. The 360 divisions of the circle were named steps, or degrees. As astronomical observations grew more exact each of these degrees was split into 60 parts, *partes minutae*, whence our minutes. These were again divided in 60 more, called *partes minutae secundae*, whence our seconds.

Photograph of the Sun

The view presented herewith is an excellent reproduction of a photographic image taken with the spectroheliograph of the Snow telescope at the Solar Observatory on Mount Wilson by



Photograph of the bright calcium flocculi of the sun, reduced from a photograph 13.3 inches in diameter, taken with the spectroheliograph of the Snow telescope at the Solar Observatory on Mount Wilson, under the direction of Dr. George E. Hale.

Dr. George E. Hale, on July 26, 1906, at 5:26 p.m. It was taken with the light of the calcium line H2, and shows the bright clouds of calcium vapor, or calcium flocculi. It is a notably fine specimen of an exceedingly ingenious device invented by Dr. Hale for securing photographic images of any

particular chemical element desired which may exhibit itself as glowing gas or vapor in the sun's photosphere. The white patches are outbursts of dazzlingly bright calcium vapor surrounding a group of large sun spots, and being expelled with great velocity from the sun's interior to a height of many thousands of miles, they indicate the play of titanic forces beneath the sun's photosphere.

A still more extraordinary outburst was observed by Dr. Hale some years ago. The brilliantly white calcium flocculi rapidly formed around and closed over a large swirling, cyclonic spot, completely shutting it from view in less than 27 minutes, and spreading till it covered a vast area estimated at 400,000,000 square miles. "An hour later the eruption had settled down, the vapors had passed away, and the group of spots looked as it did before the eruption took place." The next day a great electrical storm occurred on the earth followed by one of the most brilliant auroras that was ever witnessed in this country.

These are examples of the gigantic scale on which the mighty forces generated in the intensely heated gases of the sun are operating.

Ancestors of our Whales

Miocene.

By Prof. J. Z. Gilbert.

Branch; Mammalia. Order; Cetacea. Sub-order; Mysticeti. Family; Balaenidae. Genus and Species not determined, probably new. Locality. In the hills of Los Angeles city would seem a strange place to find whales, and yet when the conditions are studied there is no reason why whale fossils should not be unearthed there.

In fact the occasion of this preliminary sketch is a find of fragments of an ancient whale made in the miocene rocks of *Clever Cañon; at the east end of East Avenue 33, Los Angeles, California.

Whales Unique.

Whales seem from the record in the fossils of the rocks to have appeared suddenly upon the scene of action and in such well differentiated types that a more generalized ancestral form must have given rise to them, but such a type has not yet been found.

Whether they came from some gigantic land form and degenerated in taking to the water, or whether they had their origin in some water form and never developed the pelvic girdle and legs of the present mammals is yet a mystery.

The whales are unique, too, in not being a fading race shortly to become extinct, but this branch of the animal tree is green and vigorous yet producing larger and more varied forms than have yet appeared. This race might continue for millenniums were it not that it is likely to be cut short by the intrusions of man decreasing rapidly the numbers and limiting the natural supply of food.

Two distinct types of fossil whales occur: the toothed whales (Odontoceti) and the toothless or baleen whales (Mysticeti.)

Plates I and II; Fig. 1-3.

The specimens figured and briefly described below were not in situ when found, otherwise much more of the skeleton might have been obtained. If further finds and investigation bears out the present indications this find is interesting since it

*Named by Harriette Y. Gilbert.

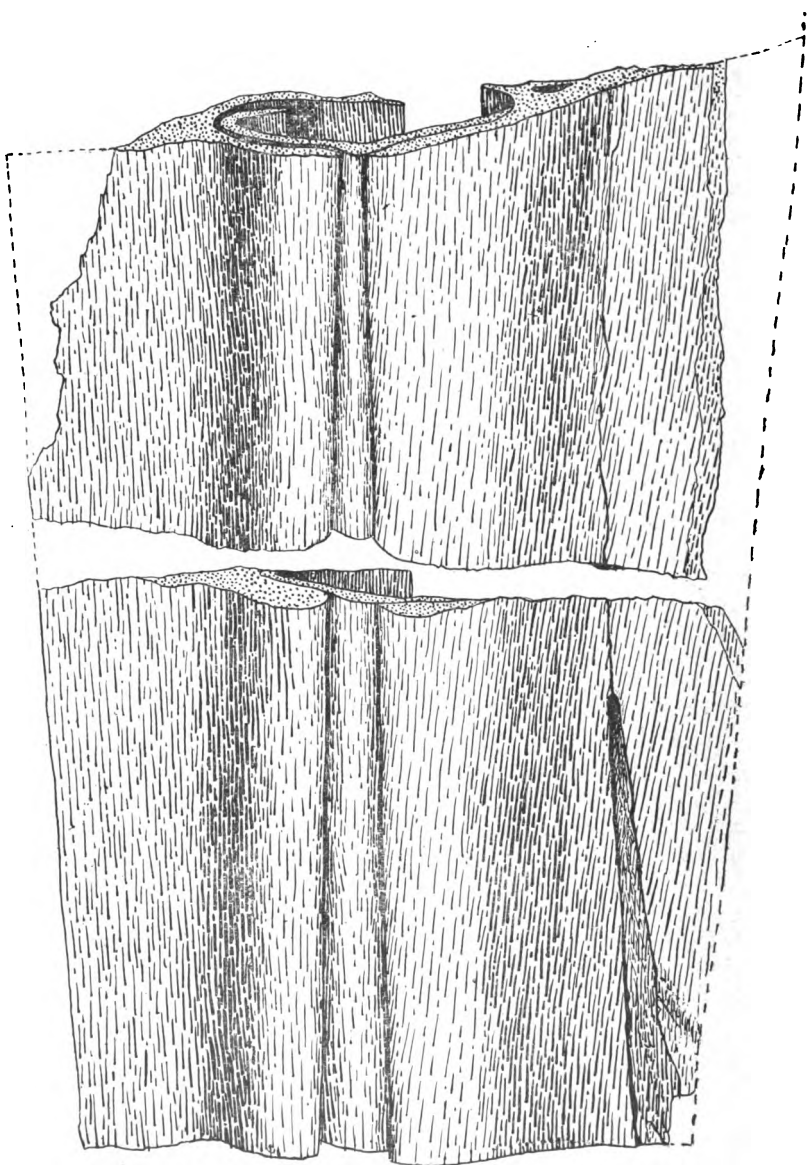


Plate I

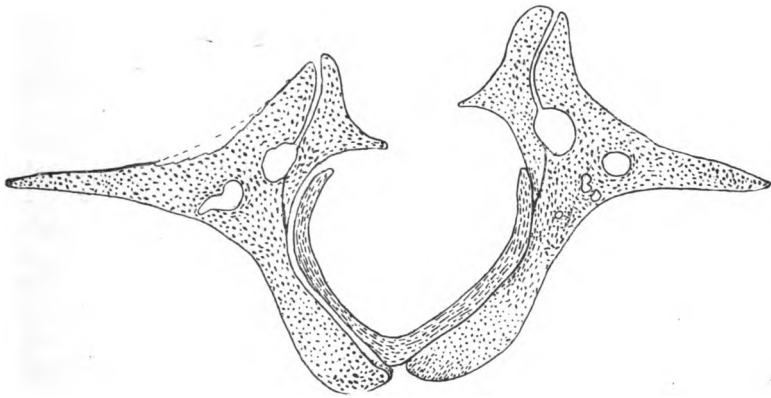


Plate II

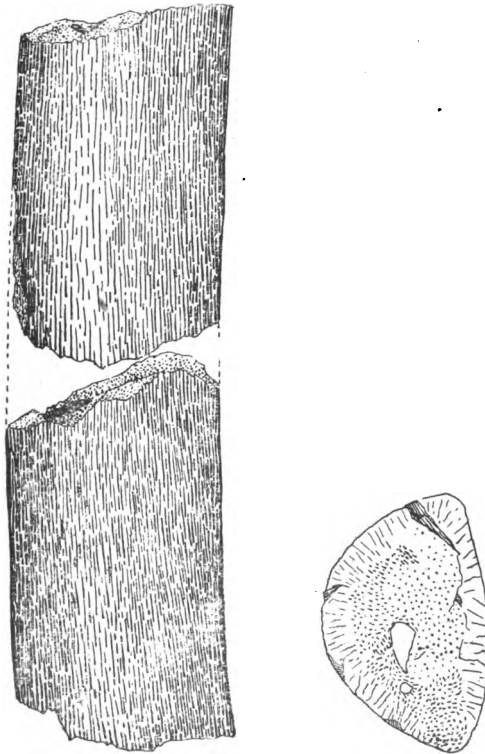


Plate III

promises to throw light upon the problem of the ancestry of our modern baleen whales.

The Find.

The find consists of two fragments of a skull evidently from the posterior middle portion of the nose part, and of parts of the low lower jaws. The fragments consist of the maxillaries, pre-maxillaries and nasal bones. The specimen in being laid down was slightly distorted, but the bones are in a perfect state of petrification.

Judging from the size of the fragments this animal when living was approximately 25 feet long, and by the contour of the lines definitely shown the skull was more elongated than that of the living whale. The maxillaries curve strongly outward posteriorly; and the nasal bone thins rapidly forward suggesting that it was very much shorter than the maxillaries and premaxillaries or that this is a specimen of a young animal, hence ossification being not complete.

The baleen surfaces are smooth and evenly curved, and a large blood-vessel path is found here. All of these points are duplicated in our living baleen whales.

The fragment of the lower jaw shows no signs of gingival dental canal or foramina, but the ramus shows a large dental canal near the center. Pl. II, Fig. 2-3. A foramen for a blood vessel appears, but no Meckelian fissure is present. The ramus is slightly curved inward and upward simulating the modern whale's jaw.

Thus the absence of teeth, and no traces of a dental groove, the slight curvature of the ramus, a centrally located dental canal, the elongated nasal portion, and the well-defined baleen surface identify this find as being an ancestral type of our modern baleen whales. I have little doubt that this specimen will prove upon further investigation to be very nearly akin to the whales that now inhabit the waters of our coast, and give to us a new species if not a new genus.

It is interesting then to note that at no distant day, geologically speaking, the hills we have at present were in the sea, the flinty sand-stones were being laid down while the predecessors of our whales sported over them and in turn died and were buried. Disintegration began and particle by particle the living substances gave place to infiltrating silicious material and the petrified form was made. It now awaited the orographic movements of our coast to land it high and dry and subsequent erosion to reveal its presence and enable us to have an idea of its interesting past.

Measurements.

Total length	37.00 cm
Width between the outer edge of maxillaries, posteriorly	31.50 cm
Width between the outer edge of maxillaries, anteriorly	27.60 cm
Vertical diameter of nasal canal posteriorly	9.00 cm
Vertical diameter of nasal canal anteriorly	4.80 cm
Width between the inner ventral margins of maxillaries	1.40 cm
Width between the inner ventral margins posteriorly	.70 cm
Thickness of the nasal bone anteriorly	.50 cm
Thickness of the nasal bone posteriorly	1.00 cm
Vertical diameter	8.50 cm
Lateral diameter	5.60 cm
Lateral curvature in 16.00 cm.	.20 cm
Upward curvature in 18.00 cm.	.25 cm
Bibliography—later.	

Plate I.

Showing the ventral surface of the maxillaries and nasal bones, exposing the baleen surfaces and a large blood vessel path.

Plate II.

Fig. 1.—View of the cross-section looking forward, revealing the relation of the maxillaries, premaxillaries and the nasal bones.

Fig. 2-3.—The longitudinal segment of the ramus showing the slight curvature and the cross-section showing the dental canal and blood vessel foramen.

The Distribution of *Juglans Californica* Wats

By Willis Linn Jepson.

The range of *Juglans Californica*, the solitary native walnut of the Pacific Coast and commonly known as California Walnut, is from the lower Sacramento to Southern California according to the more recent books of Californian botany. This statement of range does not well express the true state of the case. There are two centers of distribution, one in the north and one in the south, without connecting localities so far as I have been able to determine. In the north it occurs in the lower Sacramento region, keeping to the banks of the river islands of Andrus, Grand and others, and along streams in the valleys at the western base of Monte Diablo, specifically on Walnut Creek and Lafayette Creek. In the south it ranges from the Ojai Valley southward and eastward along the southern base of the Sierra Madres and San Bernardino range as far East at least as San Bernardino. Mr. Parish tells me its altitudinal range there is 1800 to 4500 feet. Southward it occurs in the Puente Hills according to one of my forestry students, Mr. C. N. Forbes, and in Breda Cañon of the Santa Anas on the road from Fullerton to Chino, according to Mr. C. H. McCharles, this the southernmost locality known to me. "Santa Barbara, Torrey" is a classical locality needing confirmation.

There are fine trees on adobe soil near Covina, associated with Sycamore and Live Oak. Thirteen trees in this locality selected by Miss Rea Elliott measured 4 1-6 feet to 8 2-3 feet in circumference near the ground. One may see this species to advantage in the Hollenbeck Pass on the way from Covina to Spadra. Near Azusa the trees are frequently cut down, but stump sprout freely according to Miss Harriet Smith. The same observer notes that the small trees (10 to 15 feet high) in sandy soil in the Sierra Madre foothills bear galls whilst trees in adobe soil do not seem to be so affected.

The trees of the two regions, the northern and the southern, differ somewhat. All fruits from southern trees which have come to me are small, about 3-4 to 1 1-4 inches in diameter. The fruits of the northern trees are larger, about 1 1-4 to 1 1-2 inches in diameter. The two forms also appear to differ somewhat in foliage, the northern trees having longer and broader leaflets. In the south there are two habital states; an arboreous form in creek bottoms or on banks, and a bushy several-stemmed form on cañon sides. In the north there is only the bottom-land arboreous form.

Watson published *Juglans Californica* in the Proceedings of the American Academy of Arts of Sciences, vol. 10, p. 349, 1875. He includes in this species the var. major Torrey of *Juglans rupestris* Torrey, which extends from Arizona to Texas. Excluding this form and limiting *Juglans Californica* to California it is to be decided which Californian form, the northern or southern, is to be taken as the type. Of California material Watson had before him **Brewer**, no. 65, Sierra Santa Monica and **Torrey**, 1865, Santa Barbara county, and apparently no northern material. Moreover, I think it is evident from a close analysis of the first description that the southern form must be taken as the type Watson had in mind; the first locality indication, "vicinity of San Francisco," being only a parenthetical reference to size. In any event, if one must split hairs, he puts first the term "shrub" which must refer to the southern form.

The northern form was discovered much earlier than the southern form, having been found on the lower Sacramento by the Sulphur Expedition of 1837. It may then be known as var. **Hindsii** Jepson, n. var., the botanist of the Sulphur, Richard Brinsley Hinds, being the first discoverer of the California Walnut.

Lord Kelvin

(Formerly Sir William Thompson.)

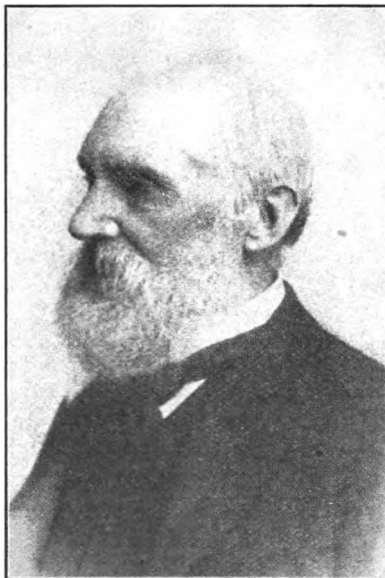
If, a month ago, the question had been asked, "Who is the most eminent living physicist?" that distinction would unhesitatingly have been accorded to the subject of this sketch. Prior to 1892 he had achieved his great fame as a scientific investigator under the more familiar title of Sir William Thompson. He earned that fame by his successful labors in many departments of scientific inquiry.

Perhaps his most useful work consisted in reducing to mathematical formulæ the relations between heat, electricity and magnetism on the one hand, and the mechanical work these agencies are capable of performing on the other. The published results of his laborious investigations in this department of science have been of great service in the mechanical arts, as precise data were thus furnished for the development of electric power, and its perfect control for practical use.

Lord Kelvin also made remarkable discoveries in the mathematical theories of elasticity, vortex motion, capillary attraction, and molecular energy. In short, his researches, always fruitful, ranged through a wide domain of theoretical and practical physics.

Born in 1824, he was educated under the eye of his father, Dr. James Thompson, who held the chair of mathematics in the University of Glasgow, but graduated at Cambridge as second wrangler. He then spent but graduated at Cambridge as second wrangler. He then spent a year in the laboratory of the distinguished chemist and physicist, Regnault, at Paris, whence he returned to accept the professorship of natural history in the Glasgow University at the precocious age of 22.

He was of a sturdy physique, and became an enthusiastic yachtsman



and skillful navigator. As his mind enriched everything he touched, he invented an improved quadrant and several marine appliances that have benefited the science of navigation, including a new method of taking deep sea soundings.

In 1849 he contributed a series of papers to the Royal Society on "The Dynamical Theory of Heat," which were epoch-making, as they placed the whole science of thermo-dynamics on a rational and scientific basis. These researches were followed, in 1852, by his remarkable discovery of "The Principle of Dissipation of Energy." It has been summed up by a writer in *Nature*, as follows: "During any transformation of energy from one form into another, there is always a certain portion of the energy changed into heat, and the heat thus produced becomes dissipated and diffused by radiation and conduction. Consequently, there is a tendency in nature for all the energy in the universe, of whatever kind it be, gradually to assume the form of heat, and having done so, to become equally diffused. This gradual degeneration of energy is perpetually going on; and sooner or later, unless there is some restorative power, of which we at present have no knowledge, the present state of things must come to an end."

These conclusions open up some interesting problems. What will be the condition of the universe after all the energy has been dissipated and diffused? Will the molecules stop vibrating? Will the planets and sidereal worlds cease to rotate and revolve? Will matter be gathered in vast aggregations, or be diffused through space in ultimate atoms?

But Kelvin was not a materialist. Life was still, to him, a great and over-mastering mystery, and in one of his papers he used this language: "It seems to me most probable that the animal body does not act as a thermo-dynamic engine in converting heat produced by the combination of food with the oxygen of the inhaled air, but that it acts in a measure more nearly analogous to that of an electric motor working in virtue of energy supplied to it by a voltaic battery." Ah, whence comes that energy which segregates life from all other manifestations of force in nature?

A few years ago, when he published a paper on "The Age of the Earth," to which he assigned a shorter period, (about 30,000,000 years,) than did contemporary geologists, his intimations that there would be a limit of but a few thousand years to its future habitability because of the rapid consumption of the oxygen of the atmosphere, were extensively commented upon, both by laymen and men of science. According to Kelvin's figures, there are about 1130 million of millions of tons of oxygen in our atmosphere, and not one ton too much. On the other hand, there is a total annual withdrawal of about 2,500,000,000 tons, caused by the respiration of human beings and animals, and the combustion of wood and coal fires. Happily this loss of oxygen is being

partially restored from a natural source of supply, for every tree, shrub and tiny blade of grass is an oxygen maker.

Like all men of great scientific attainments, Lord Kelvin was richly endowed with imagination, and his statements were often tinged with poetic fancy. He not only saw with clear mental vision, but he enabled his reader to perceive, with equal cleverness, a molecule, for instance, the one hundred millionth of a centimetre in diameter, colliding with its fellows 5,000,000,000 times in a second, for observed phenomena, coupled with irresistible logic, demonstrates the existence and incessant motion of these infinitesimal particles of matter, and the trained imagination pictures what the mind predicates.

Therefore, although his voluminous scientific papers deal with abstruse subjects, intangible materials, occult forces and intricate mathematical formulæ, he commands a style so lucid and engaging that his works are read with pleasure by any whose tastes lie in that direction. These qualities also made Lord Kelvin a favorite lecturer, and he addressed many distinguished assemblies on "The Kinetic Theory of Gases," "The Functions of the Six Senses," "The Nature of Electrical Phenomena," "The Marvels of Capillary Attraction," and other themes dealing with the mysterious forces of nature.

WILLIAM H. KNIGHT.

Report of the Secretary of the Academy for the First Half Year, 1907-1908

The report of the Secretary for the year 1906-1907 went to print for the Bulletin of that year before the June meeting of that year was held; hence, the meeting for that month is included in the present report.

Being the closing meeting for the year, the reports of the officers and sections of the Academy were read, showing very satisfactory progress in the growth and work of the Academy during the year then closing, which reports were included in the Bulletin of July, 1907. The President briefly addressed the Academy on "Scientific Bodies Abroad," giving a resumé of his observations while visiting scientific institutions in Europe, in 1906. The Academy was also addressed by Mr. B. Fay Mills, on the suggestive topic, "Southern California as a Field for Scientific Research and Human Culture," showing the unsurpassed facilities of this favored spot for promoting all that pertains to the highest development in every department of human progress, and indicating the manifest destiny of this section to be the seat of an all embracing aesthetic culture second to that of no place on earth. After music, very acceptably rendered by Mr. C. A. Faithful, the leading feature of the evening's program was announced as a lecture by President Baumgardt, on "Russia, Her Scientific Men and Institutions." Aided by

stereopticon views of striking interest and surpassing beauty, gathered during his travels in Europe in 1906, the speaker held the rapt attention of the large and appreciative audience for more than an hour, while he presented the physical, geographical, social, political and scientific phases of Russia's history and present condition. A brief time spent in social intercourse with light refreshments brought the evening and the Academy's most successful year to a delightful close.

No public meetings of the Academy are held in the months of July, August and September.

On August 29th, at a called meeting of the Board of Directors, the Secretary was authorized and instructed to prepare a circular letter to the members of the Academy, setting forth the unselfish purposes of the Academy, its desire to reach the ear of the people for instruction in matters scientific and historical, and its dependence upon the small annual dues of its members to meet the current expenses, and an appeal to the membership to put forth an extra effort to materially increase our numbers during the coming year. It was also resolved that hereafter only two Bulletins should be issued each year—one in January, and one in July, and that earnest efforts should be put forth to make these publications in every way worthy of the Academy.

At the first regular meeting of the current year, held October 7, 1907, the Board of Directors elected twelve persons to membership in the Academy, indicating the good fruit that was being borne by the circular letter that had been distributed among the members.

The Directors also decided that each section of the Academy should be represented in the Bulletin in a leading article on some topic within the scope of its particular work, and that colored plates illustrating the birds and butterflies of California should be authorized.

At the assembling of the Academy Vice-President Knight presided, and introduced the program of the evening by a brief review of the recent occurrences of importance in scientific circles; calling attention to Sir Wm. Ramsey's success in transmuting copper into lithium; to Prof. Le Duc's attempts to produce vegetable life; to the renewed interest in Botany, incident to the celebration of the bi-centennial anniversary of the birth of Linneus, the recognized father of systematic Botany; to the unusual interest centered in the study of the planet Mars at this time, during its "favorable opposition," and to the recent appearance of Daniel's comet.

The regular program of the evening was then taken up by Dr. C. A. Whiting, Chairman of the Biological Section, who spoke of the nerve centers and nerve action of the human body. Dr. Whiting gave an interesting and lucid explanation of the nerve system, both in its structure and its functional activity; illustrating his thoughts by blackboard diagrams. He was followed by Prof. George Leslie, head of the science department of the public schools of Los Angeles, who spoke specifically

of the sense organs and the structure and functions of the brain.

Prof. Leslie went very minutely into the various phases of brain activity, and especially of disordered functions; demonstrating the importance of great care in the early life of a child to detect and correct any failure of correct functioning. The lecture was profusely illustrated by stereopticon views, showing the structure of the brain in great detail and the peculiarity of the nerves leading to and from it. Prof. Leslie's talk was but an exposition of the work he and his assistants are attempting to accomplish among the thousands of children attending the public schools of the city.

The several sections of the Academy reported their organization for the coming year, as follows:—

Astronomical Section, Wm. H. Knight, chairman; H. O. Collins, secretary. Biological Section, Dr. C. A. Whiting, chairman; Dr. C. H. Phinney, secretary. Geological Section, W. H. Storms, chairman; G. Major Taber, secretary. The Chairman announced that Carbon would be the subject for consideration at the November meeting.

At the meeting of the Board of Directors, in November, eleven persons were elected to membership in the Academy.

In the absence of President Baumgardt, Vice-President Knight again presided, and announced that at the December meeting the subject of City Parks and Street Ornamentation would be under consideration.

Preliminary to the main topic of the evening, Mr. Wm. A. Spalding was introduced, and read a most interesting and instructive communication from Father Gangotti, Superintendent of the Weather Observatory, at Havana, Cuba. Mr. Spalding read an introductory note from Mr. H. O. Collins, giving a brief sketch of the work of Father Gangotti, emphasizing the remarkable accuracy that has characterized his predictions of weather conditions, especially in connection with the destructive Galveston storm and others of unusual violence.

Mr. Spalding followed the reading of the observer's communication with a brief discussion of its contents, illustrating his ideas by diagrams on the board.

A vote of thanks was heartily and unanimously extended to Father Gangotti for his very valuable contribution to the Academy. The Chairman then introduced Prof. W. L. Watts, for the discussion of the subject of Carbon from the standpoint of a mineralogist. The speaker, with the aid of charts showing the difference between the atom and the molecule, and also the various chemical compounds of carbon, proceeded to treat the characteristics of this most interesting and all pervading element under the several heads of diamond, graphite, coal, charcoal, petroleum, and carbonic acid gas. In these widely divergent forms he traced the identity of carbon as the chief element in each and the sole component of some, giving a clear exposition of the chemical attributes and a striking demonstration of the practical value of carbon.

The discussion was continued by Prof. J. Z. Gilbert, of the department of science in the Los Angeles High Schools, from the standpoint of the relation of carbon to the plant and animal life of the globe. At great length and with scholarly exactness, Prof. Gilbert depicted the numerous and marvelous combinations upon which animal and plant life are dependent, in all of which carbon plays a most conspicuous part. He also showed the utter hollowness of the pretensions recently made to the production of life by artificial chemical compounds; proving all apparent vitality and growth under such conditions to be mere accretions, without the presence of the all-important life germ.

At the December meeting of the Board of Directors seventeen persons were elected to membership in the Academy.

At the opening of the general meeting of the Academy, Vice-President Knight read a letter from Prof. Hale, Director of the Mount Wilson Observatory, transmitting to the Academy two magnificent photographs of the Sun, recently taken at the Observatory, showing the sun-spots with striking definiteness, one picture exhibiting the calcium flocci and the other the hydrogen flocci. Copies of these pictures are to appear in the Bulletin. After delivering a brief but eloquent answer to the question, "What has Science to do with Beauty?" the Chairman introduced the first speaker of the evening, Mr. Edward J. Harper, City Forester of Los Angeles, who spoke fluently and most instructively on the topic of beautifying the streets of the city by planting and cultivating systematically the shade trees best adapted to the purpose. Mr. Harper displayed a remarkable familiarity with his subject, and entered with such spirit and interest into his topic as to carry his audience with him into all the details of his address, which abounded in that which is eminently practical in closest touch with the most aesthetic. At the close of the Forester's address, the Chairman introduced Mr. H. W. O'Melveny, formerly a member of the Board of Park Commissioners, who delivered a carefully-prepared and very valuable paper on the "Functions of Park Development in Beautifying the City." The speaker treated his subject with much breadth of view and in a scholarly manner, showing the large and important part played by public parks in the development of the highest physical, intellectual and moral life of a community, and emphasizing the immense advantage enjoyed by Los Angeles in this respect, especially in the great areas dedicated to park purposes, but not yet rescued from their nature state.

These two addresses, on subjects of such practical local value and interest, were a revelation to those present of the untold possibilities of healthful and attractive ornamentation in our streets and parks, adding immensely to the attractiveness of our city and the pleasure and profit of our people.

MELVILLE DOZIER, Secretary.

Astronomical Section

The Astronomical Section has been holding its sessions at the lecture room at the residence of S. J. Keese, 1509 Shatto street, since the opening of the present season.

At the October meeting interesting facts regarding Daniel's great comet, which arrived at perihelion September 4, were brought out by Chairman Wm. H. Knight. The comet approached within 48,000,000 miles of the sun, about half the distance of the earth from that body, and was consequently subjected to intense heat. Though an object of extreme tenuity, its bulk exceeded that of the sun, and there streamed from its bright nucleus a tail 15 degrees in length upon the celestial vault, but projecting into space a distance of 20,000,000 miles, in a direction opposite that of the sun. Being the brightest of the comets which have visited our northern heavens since that of 1882, it was carefully studied with those scientific aids—the telescope, the spectroscope and the camera, all of which have been brought to a high degree of perfection during the last quarter of a century. As a comet approaches the sun, its frozen, dormant gases are vaporized and enormously expanded, and a fierce internal commotion, chemical and electric, is set up, a violent ebullition takes place, the dissociated molecules appear to be projected with great energy, and are then repelled by the sun's rays, or some electrical or other mysterious force, and the electrons or radiant matter thus set free are sent flashing far out into interplanetary space. The orbit of Daniel's comet approximated that of a parabola, and it moved round the sun with a velocity so great that it may be carried beyond the powerful attraction of that monarch of our system, never again to return to this portion of the universe.

The November evening was devoted to lantern views of a large number of interesting celestial objects, including views of the moon, spectra of the sun, phases of Venus, polar caps of Mars, belts of Jupiter, ring system of Saturn, principal comets of the 19th century, double and multiple stars, and brilliant star clusters.

The complex nature of the multiple star Polaris was shown by diagrams on the blackboard. In the first place there is the well-known telescopic double, the small companion being of the 9th magnitude and having the same proper motion as its primary. Second, Director Campbell of the Lick Observatory,

has ascertained that the primary is itself a spectroscopic double with a period of four days, and a high velocity of revolution round a common center of gravity. Third, these two bodies appear to be moving in a large orbit, comparable to that of Jupiter, round a third massive, dark body, whose existence is inferred from the otherwise unaccountable perturbations of the primary which has alternate motions in the line of sight of advance towards, and recession from, our own system. Finally, the bright companion, immensely more distant, slowly circling in a vast orbit about the other three bodies. Thus the familiar North Star, which to the unaided eye is a single point of light, becomes a double with a bright companion in a telescope of moderate power, then the spectroscope reveals the duplicity of the brighter component, and further research transforms the latter into a triple system consisting of one bright and two dark bodies, and around all three revolves the bright telescopic companion—altogether forming an exceedingly complex quadruple star.

Tree Growth and Sun Spots

The meeting of December 30 was reported as follows in the Evening News:

Exceedingly interesting was the session of the astronomical section of the Academy of Sciences held last evening at the residence of Treasurer S. J. Keese, whose pleasant parlors were thrown open for the occasion. After several views of Lake Tahoe and vicinity were exhibited by Mr. Keese, Chairman William H. Knight introduced Prof. E. A. Douglass of the University of Arizona, formerly assistant astronomer of the Lowell Observatory at Flagstaff, where he engaged in original research work of a novel nature.

Here Professor Douglass became deeply interested in tree growth as attested by the annular rings disclosed in cross-sections of giant pins from 300 to 500 years old. By examining the cross-sections of many large logs, the professor was enabled to compare them with each other, and note the fact that all alike showed large growth in the years following rainy seasons, and meager growth in dry seasons. He thus found a sure criterion of rainy and dry years for periods reaching back to the century before Columbus discovered America.

Finally, searching for the cause of that periodicity, he noted the fact that it accorded fairly well with the alternating maximum and minimum sun spot periods, thus bringing out the hidden relations of sun spot activities, seasons of unusual rainfall, and vigorous or feeble tree growth. W. A. Spalding, who has been engaged in noting the correspondence between sun spot activity and seismic disturbances, regarded the discovery of Professor Douglass as a remarkable corroboration of his own views as expressed in a lecture given before the academy several months ago.

B. R. Baumgardt, president of the academy, who has recently returned from Europe, received an ovation from the club. He spoke at length of many of the interesting astronomical relics he had seen in Europe.

Biological Section

The Biological Section of the Academy has started on what promises to be an unusually successful year. The meetings up to the present have been held at the Pacific College of Osteopathy on the corner of Daly and Mission streets, and it is probable that the meetings will be held at this place during the entire year. The attendance has been good, averaging from twenty to sixty each evening. The October meeting was addressed by Dr. C. A. Whiting; his lecture being on "The Smithsonian Institute," at which place he spent considerable time during the last summer. Professor Miller, of the State Normal School, addressed the November meeting on the subject of "Desert Plants." His lecture was especially interesting and instructive. The December meeting was addressed by Professor Gilbert, of the Los Angeles High School; his subject being "Some Pacific Coast Fossils." Prof. Gilbert's lecture deserves much more than passing comment not only because of the interest such a subject excites, but also because of the pains taken by the lecturer to illustrate his subject, with this end in view he brought with him a large number of specimens, the aggregate weight of which must have been much over one hundred pounds.

It is believed that the meetings for the rest of the year will be quite as valuable from an educational standpoint as those which have already been held.

CARL H. PHINNEY, Secretary.

Geological Section

During the months of October, November and December, 1907, the geological section of the Academy met once each month and these meetings were each much enjoyed by all present, and we believe were not without profit to each of us.

On the evening of October 21, this section met at the residence of Wm. H. Knight, when a number of gentlemen were present most of them mining engineers. On this occasion W. H. Storms described the geology of the noted Homestake mine in South Dakota, together with something of its history and development. Following this there was general discussion of the Homestake and ore deposits in general, in which all present took part.

On the evening of November 18, the geological section again met on this occasion at the residence of Mr. S. J. Keese. The subject for the evening was the Yellow Aster Mine at Randsburg, Kern County, California, which was described by Mr. Storms chairman of the section. The Yellow Aster mine is a geological anomaly, and its description is not an easy task, still all present, among whom were a number of ladies seemed

to understand and thoroughly enjoy the subject, particularly the discussion at the conclusion of Mr. Storms remarks.

The latter part of this evening was taken up by Professor W. L. Watts, who gave a short lecture on volcanoes, illustrated by stereoptican views, including several most interesting views of volcanoes in various parts of the world. Mr. S. J. Kees also added to the evening's pleasure by giving a description of the eruption of Mount Pelee, on the island of Martinique, West Indies. The description was illustrated by numerous interesting stereoptican views. Mr. Keese was well qualified to present his subject having visited the scene of that terrible disaster.

On the evening of December 16, at the residence of Mr. Keese, Professor Watts again lectured on the oil and gas yielding formations of Los Angeles and the Puente hills. This lecture was of thoroughly practical interest and the conditions under which oil and gas occur in the territory referred to.

This meeting was attended by about twenty ladies and gentlemen who evinced a most hearty interest in all that was said by Professor Watts, who is the best authority in California on the subject of the occurrence of oil and gas.

All-Inclusiveness of Science

The subject announced for the December meeting of the Academy was, "Beautifying the City." Prior to the meeting a person who had received the notice querulously asked, "What has Science got to do with Beauty?" The following reply was read from the platform, by Vice-President Wm. H. Knight:

"What," it is asked, "has Science got to do with Beauty?" Certainly a pertinent and very proper question. The Academy of Sciences is organized for the purpose of promoting research in natural science, and diffusing a knowledge of its truths. The question implies that the Academy would best serve its purpose by keeping within its own sphere. But those who are familiar with the present trend of human thought and research, realize that the realm of pure science has so extended its borders in recent times that it has become all-inclusive in the scope of its investigations.

Just half a century ago, that master mind of a former generation—Herbert Spencer—put forth the first volume of his marvelous work, in which he classified and summed up all human knowledge, demonstrated the unity of Nature, and affirmed that all the varied phenomena of which the mind can take cognizance, may be reduced to an orderly scientific

sequence, and is subject to the single and inviolable law of Evolution.

Thus, every department of human inquiry, whether it be invisible atoms, or mighty suns wheeling in space; whether simple cells of protozoa, or the involved structure of anthropoid species; whether a co-operating colony of ants, or that complex social organism, a civilized State; whether the dawning mentality of a spider that plans where to spin its web, or the intellectual grasp of a thinker who, shackled to this little island world flying helplessly through the fathomless abyss, yet stands erect, grapples with the problems of the Universe, penetrates their deep mysteries, and proudly enrolls himself a spark of, and a co-worker with, the Infinite; I say that every phase of the myriad facts thus engaging our attention, is classified and filed for reference in the archives of that wonderful museum—the Temple of Science.

But, reverting again to the question, “What has Science got to do with Beauty?” we are reminded of the pregnant phrase of the French philosopher Cousin, who discoursed of “The True, the Beautiful, and the Good.” Note how well it fits this occasion. The True—scientific facts, the basis of all knowledge. The Beautiful—form, color, proportion, all fundamentally dependent on scientific formulæ. And the Good—that is, the useful and altruistic, the part each one plays in serving others and making them happy.

Science is the groundwork of a piece of rich tapestry; beauty and utility are the interlacing threads of grace and beneficence, investing the matchless fabric with inexpressible charm.

The Constitution of Matter.

A good idea of ions, electrons and the present accepted views of scientific men regarding the constitution of matter, may be obtained from a perusal of a little volume just issued by Wm. Lawrence Woodruff, M.D., under the title “Therapeutics of Vibration.” Dr. Woodruff claims in his preface that “we are now just entering the transition period from the Electrical Age to the Age of Vibration.” Of course light, electricity, the Roentgen ray, and radium, each play an important part in his elucidation of the thesis that “Vibration is the primal law of the Universe.” The author gradually leads up to a medical application of his subject, which, if not convincing, is at least plausible and informing so far as its scientific basis is concerned.—Elwell Publishing Company. Los Angeles.

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*Southern California Academy
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OF THE
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COMMITTEE ON PUBLICATION:

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William H. Knight.

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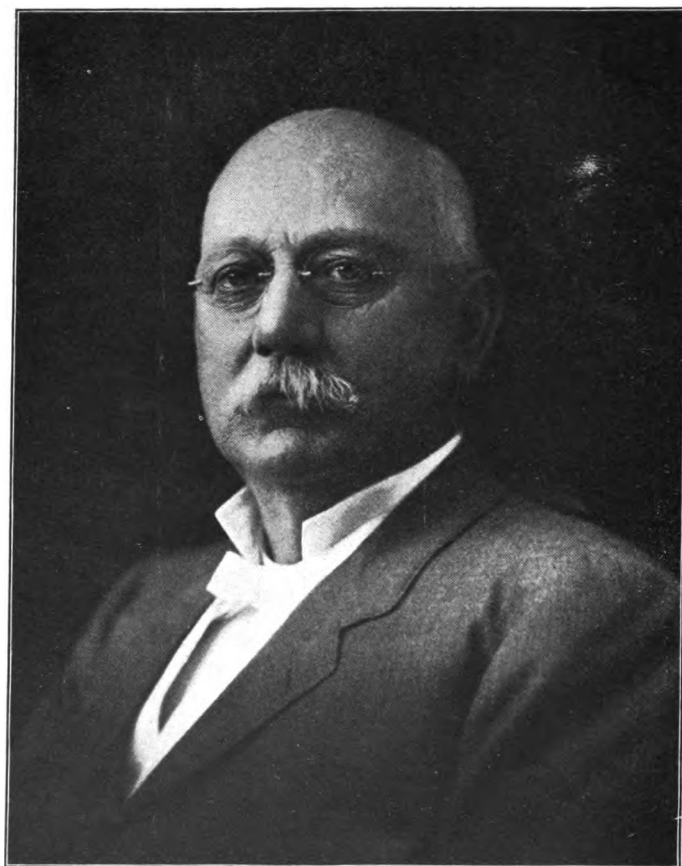
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JOHN DAGGETT HOOKER.



Editorial

With this number we commence Volume eight of the Bulletin, and it has been decided by the Directors of the Academy that future publications shall be regularly issued in July and January.

Six years ago this month the first number of Volume I was sent to members. That number was a small pamphlet of only twelve pages, less than six of which were devoted to scientific matters. It was tentative only, as there were grave doubts that the time was ripe for such a venture in this new city. Happily all fears as to the success of the project proved groundless, for the Bulletins met with an immediate welcome by the members, and from the first number they were very favorably received by the foreign scientific Bodies to which they were sent.

California presents a very rich, and in some features an unique field for scientific investigation. The great cañons, or gashes in her lofty mountain chains; the fossil trees, so closely related to our gigantic conifers, washed out of the tufa which was discharged from Mt. St. Helena before its extinction as a volcano, and now forming the petrified forest of Napa county; the wealth of minerals and the newly discovered gem-studded Colorado Desert of San Diego county, exhibit for investigation a field of geological wonders more diversified in its character than is found in any other part of our country, and probably in the known world, and nowhere has the biologist found so wonderful an assemblage of aquatic life as in the semi-tropic waters of the Pacific which lave her shores. Our equable climate affords exceptional advantages for astronomical observations, and a study of our flora has revealed curious, rare and valuable plants found in no other land, while the excavations on the Channel Islands and in the localities which were the habitat of the extinct tribes of this Coast, have revealed new and curious matter for study by the ethnologist.

All of these subjects have been discussed, accompanied by numerous and excellent illustrations, in our Bulletins, and these papers have attracted the attention of learned specialists.

During the short period that has elapsed since the election of the present Secretary, he has had numerous requests from Libraries, Universities, Academies of Science, and other learned Bodies all over the United States, not only for specific numbers, but for complete sets of the Bulletin. He has been unable to satisfy the demand, as there are only six complete sets remaining among the property of the Academy. There are, however, ten other sets nearly complete, some of them lacking but two numbers; and in another place will be found a call for these missing publications.

A Few Words Relating to the Academy.

In 1891 it had its inception as The Southern California Science Association, which designation was changed in 1895 to the present name. The Founders were few in numbers and weak in financial resources, but enthusiastic in their determination to effect a permanent Scientific Organization. Many of the original associates in this work are today among the most active and zealous members of the Academy.

Through the long years of trials, discouragement and pecuniary difficulties they at no time lost courage, and from their own liberality they met all deficiencies in the expenses of the work. No Macedonian cry of "Come over and help us" was ever heard from them, and we, the later members, are now enjoying the results of their splendid labors, which have placed this Academy of Sciences upon an enduring basis. Surely the unselfish spirit, free-handed liberality and courageous independence of those men and women may warrant them in demanding as the motto of this Corporation, "Nostra Tuebimur Ipsi" for the future, they have so strenuously lived up to it in the past.

Holbridge Ogro Collins.

For many years it has been suspected by Astronomers that there is a planet of our system, moving in an orbit beyond that of Neptune, but there has been no Adams or Leverrier to demonstrate its position.

On the first day of this month the news was flashed around the world that Professor Pickering, Director of the Harvard Observatory, had found upon the sensitive plates an ultra Neptune planet in the Constellation Gemini, and very near the place at which Uranus was discovered by William Herschel. All Astronomers will await, with intense interest, the verification of this discovery.

H. O. C.

Additions to the Southern California Flora

S. B. Parish.

Chloris elegans H.B.K. Nov. Gen. et. Sp. 1:166. Roadside at Riverside, Aug., 1904, F. M. Reed, where perhaps only a waif. Reported by Beal (N. Am. Grasses, 2:403) from "California," but without definite locality. There is a specimen in the herbarium of the University of California, collected by Mr. E. E. Sellenger, on flood lands of the Colorado river, near Palo Verde. In that region it is certainly indigenous, and probably not infrequent.

Eleusine indica Gaertn. Fruct. et Sem. 1:8. In a lawn at Los Angeles, 1907, E. Braunton. This is the first reported appearance in California of this widely distributed tropical and sub-tropical grass.

Cyperus virens Michx. Fl. 1:29. Banks of Warm Creek, south of San Bernardino, Oct., 1907, 6165 Parish. The southern known limit.

Polygonum Kelloggii Greene, Fl. Fran. 134. In wet soil, at high altitudes in the San Bernardino mountains. Bluff Lake, 7,400 feet altitude, Mrs. H. E. Benton, July, 1908. Bear Valley, 6,500 feet altitude, Aug., 1882, 1509 Parish.

Calandrinia Breweri Watson, Proc. Am. Acad. 11:124. City Creek road, San Bernardino mountains, at about 2,000 feet altitude, May, 1907, 6221 Parish. The type was collected by Brewer in the Santa Inez mountains, and the present locality is the southern limit.

Radicula obtusa Greene, Leaflet, 1:113. **Nasturtium obtusum** Nutt. T. & G. Fl. 1:74. Bluff Lake, Aug., 1908, Mrs. H. E. Benton. The southernmost locality reported for the west coast.

Cardamine oligosperma Nutt. T. & G. Fl. 1:85. Topanga cañon, Santa Monica range, Los Angeles county., March, 1908. Dr. H. E. Hasse.

Mentha arvensis L. var **glabrata** Fernald, Gray's Man. 7th Ed. 711. Bluff Lake, San Bernardino mountains, Aug., 1908, Mrs. H. E. Benton. Not heretofore reported from the Pacific coast. The variety **canadensis** is common at lower altitudes.

Veronica arvensis L. Sp. Pl. 14. In lawns, Soldiers' Home, Los Angeles county, July, 1900, Dr. H. E. Hasse; Riverside, June, 1907, F. M. Reed.

Plantago fastigiata Morris, Bull. Torrey Club 27:116. Coachella, Colorado desert, 595 L. A. Greata. Identified by Mr. E. W. Morris. In his original description, Mr. Morris gives the habitat as "Arizona and Southern California," but cites no localities. The plant belongs to the desert flora.

Plantago virginica L. var. **longifolia** Gray, Syn. Fl. 2, pt. 1:392. Corona Bluff, Orange county, May, 1908, Dr. A. Davidson. Not before reported from California.

New Botanical Records for Los Angeles

A. Davidson, M. D.

The year 1908 has added but few new records for our county, and some of these are at present only casuals. It is always of interest to record the first appearance of what may seem but an unimportant introduction, as experience has shown that it is not always possible to foresee the ultimate result thereof.

Vaccaria Vaccaria Britton. Along a ditch on Lima street, Sierra Madre, a few plants. This is the troublesome "cockle" of the wheat fields in the Middle West, and I think this is its first reported appearance in California.

Silene noctiflora L. Lawns at Alhambra.

Madia Wrightii Gray. Half a dozen plants on Drumholly, Hollywood. Probably introduced.

Gilia ochroleuca Jones. Common in my garden for the last two seasons. For a number of years I have observed occasional plants of this species in the neighborhood of Los Angeles, but I was unable to identify them. Mr. Parish kindly named it.

Convolvulus Binghamiae Greene. Common in most grounds at Rivera; San Gabriel River; Cienega, etc., and as heretofore passed as **C. sepium** or **C. repens**.

Cakile californica Heller. Is abundant at Balboa and Corona del Mar beaches, and probably extends to our coasts adjoining.

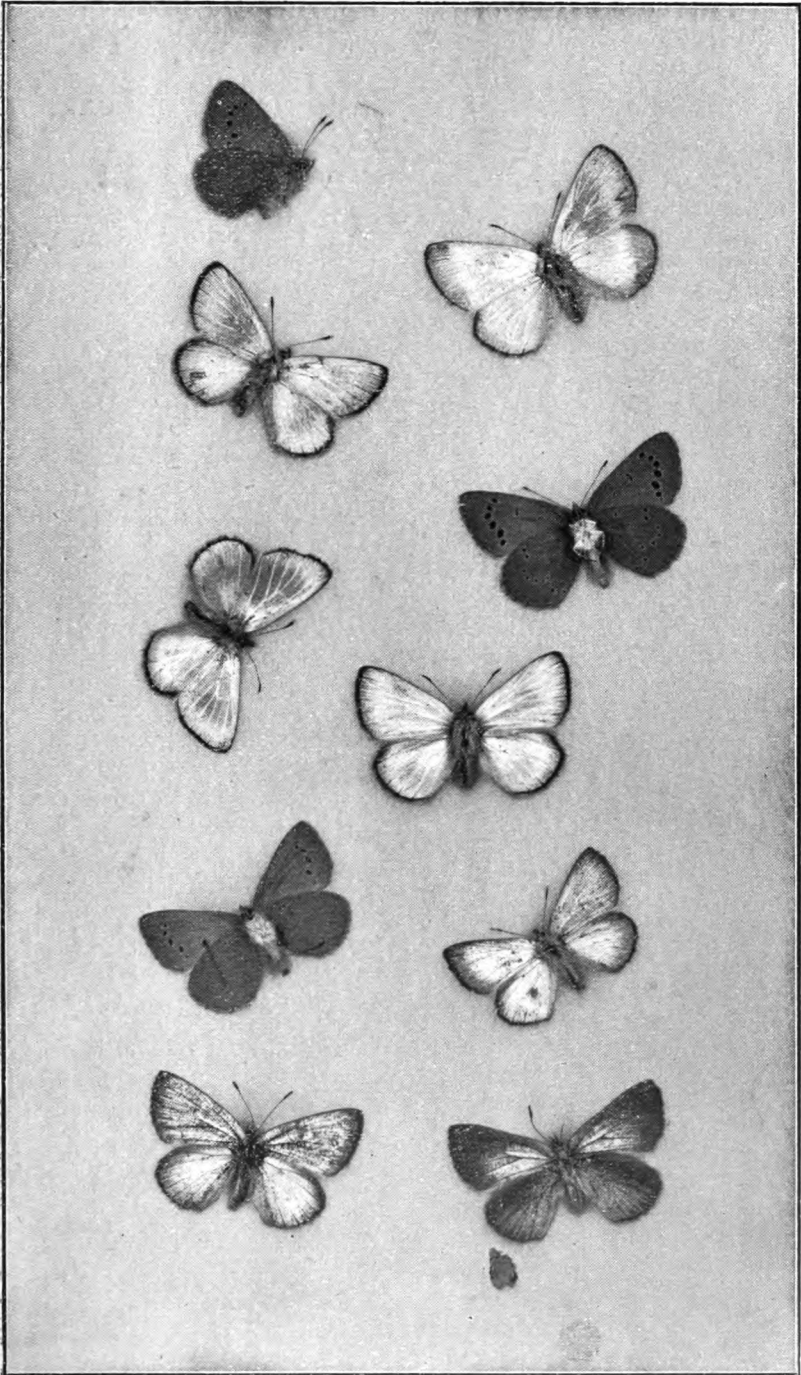
Lotus hematus Greene. This plant, common enough in Catalina, was found for the first time in the mainland on Providentia ranch, Hollywood.

The Blue Butterflies

By J. R. Haskin.

On account of their small size but few people except collectors realize how numerous, both in species and number, are the Lycaenae, or Blues. Although so small, there is enough variation among them to justify their classification into thirty-eight species in a popular work on North American Butterflies. Another able writer actually classifies fifty species on the Pacific Coast side of the Rockies.

They are essentially a Western genus, as, although several species are common enough, there are hardly as many species in the whole country east of the Mississippi as can be taken in a day's outing in the country about Los Angeles. Within the possibilities of such a day at least a dozen species are available to the student. The illustration of *Lycaena Antiacis* shows a typical species of this beautiful group. A trip to the foothills and gullies, near Newhall for example, in April or May, can hardly fail to bring in a choice set of them.



Lycaena Antiacis
The Eyed Blue

The One Hundred Inch Reflector on Mount Wilson, California

By Holdridge Ozro Collins, LL. D.

It is a subject for comment that the largest telescopes throughout the world have been constructed by the liberality of individuals, and perhaps a majority of the greatest discoveries, as well in Astronomy as in the other Sciences, have been made by those, working in a private capacity, with their own instruments and in their own observatories, and having no connection with any public institution.

From Galileo's small objective, with a magnifying power of only 33 diameters, which in January, 1610, first presented to an amazed world the four moons of Jupiter, the list down to the present is a long one, embracing the 48 inch Reflector of Herschel in 1789; the six foot Reflector of Lord Rosse in 1845; the five foot Reflector of Dr. Ainslie A. Common in 1889; the Lick Equatorial of 36 inches; the Yerkes Equatorial of 40 inches; the 60 inch Reflector just completed, and the Snow horizontal Reflector of 24 inches, both on Mt. Wilson, and an innumerable number of powerful instruments with objectives from 12 to 28 inches in diameter, all of which have been constructed and operated without government aid.

The creation of a perfect achromatic Refractor is much more difficult than that of a Reflector of the same aperture, and it is thought that the limit has been reached in the size of the Refractor objective, owing to the elliptical image resultant from the flexure of a large suspended object glass. The objective of the Refractor constructed for the Paris Exposition of 1900, is 50 inches in diameter, but it was found impossible to mount it as an Equatorial, and it was placed horizontally upon piers, objects being reflected into it by mirrors.

For the Reflector, however, the spuculum which will give a perfect and sharp definition, can be made much larger than is possible for a practicable Refractor objective of a corresponding size.

Between the years 1660 and 1670, Sir Isaac Newton and James Gregory, working independently, discovered the advantages of the Reflector.

In the youth of the Reflector, the speculum was made of various alloys of silver, nickel, zinc and arsenic, and later, almost universally of copper and tin, with perhaps a small amount of arsenic to increase the whiteness. This form is

found at the present time to some extent, but silvered glass has proved itself superior in many respects, and it is being now generally used.

A few years ago the Carnegie Institution of Washington decided to erect a 60 inch Reflector, for a Solar Observatory, and after a careful examination of many localities, Mount Wilson was selected. Its summit being nearly 6000 feet (5886), above the ocean; located but a short distance from Los Angeles, the Metropolitan City of Southern California; in a district exempt from tornadoes, cyclones and hurricanes; above the fogs; with an equable climate and an atmosphere phenomenally free from disturbances, it offered advantages not equaled by any other known place; and here has just been completed the erection of the 60 inch Reflector.

During the last decade of the marvelous growth of Los Angeles, one of her most energetic, public-spirited and prosperous citizens has been John Daggett Hooker. A man of unassuming personality, identified with all good works for the advancement of the material interests of Southern California, and, from a modest beginning achieving a distinguished position in the mercantile world, he has been a leader among those working for the higher intellectual advancement in our midst, more particularly in the way of affording facilities for scientific pursuits. In early youth he became interested in Astronomy, and this interest has been maintained by study and observation down to the present time during a life of close application to avocations which, to most persons, would have proved an element of distraction. Several years ago he purchased a Byrne five inch objective, and, fitting out the entire upper story of his spacious Colonial residence on Adams street as an Observatory and work room, he not only entered upon a systematic observation of the outer worlds, but he placed all his instruments and his residence and grounds at the unrestricted use and occupation of the Astronomical Section of the Southern California Academy of Sciences, of which he has been a member almost since its inception.

Mr. Hooker had become profoundly impressed by the work with the Crossly Reflector on Mt. Hamilton and with other Reflectors which had disclosed the wonders of Nebulae never seen by the eye, and beyond the powers of definition by the largest Refractors, except upon the sensitive plate after long exposure, when used for photographing.

If a sixty-inch Reflector will accomplish more than has been done by the Crossly, what will a hundred inch speculum disclose? The construction of such an instrument would be the work of comparatively a short time, and a vigorous constitution and years but little past the middle age gave promise

that he might live to explore through a telescope of this magnitude, the realms far beyond what we now call outer space. Enthused by this thought, he entered into communication with the Carnegie Institution at Washington, and offered to give the sum of Fifty thousand Dollars for the manufacture of a Reflector of this size. The proposition was accepted and there was no delay in prosecuting the work. The order for the casting of the glass disk was given in September, 1906, to the French Plate Glass Companies at St. Gobain, France, and during the year between the Spring of 1907 and June, 1908, six or eight castings were made.

In order that there might be no delay in grinding polishing and figuring the disk after its arrival, Mr. Hooker constructed at Pasadena, in the Winter of 1907, a building which he supplied with all necessary appliances. The main room is 34 feet square and 20 feet high, and opens into a long testing hall.

"The walls of this room are very heavy, made of brick laid in cement, and covered with a roof of reinforced concrete. This portion of the building, which is separated from the other part by iron doors, may therefore be regarded as fire and earthquake proof—a consideration of no small importance, in view of the nature of the work to be done within it. A heavy steel I-beam, supported over the doorway, carries a traveling crane, by means of which the mirror-disk and heavy parts of the grinding-machine, one of which weighs 3.5 tons, can be brought into the room and handled when necessary during the progress of the work. The testing-hall, 100 feet long and 10 feet wide, will permit the mirror to be tested from the center of curvature or with parallel light. . . . On one side of the testing-hall are rooms for the grinding and polishing tools and for the apparatus required to maintain the polishing room at a uniform temperature. There is also a large fireproof vault, for the storage of astronomical photographs. On the other side of the hall a series of computing offices is provided, affording, with the rooms already available in the adjoining building, suitable accommodations for a large staff of computers."*

In June, 1908, information was received at Los Angeles from the Glass Companies at St. Gobain that the casting of a perfect disk 102 inches in diameter, $13\frac{1}{4}$ inches thick and weighing $4\frac{1}{2}$ tons, had been successfully accomplished. On December second, 1908, in its iron case, it reached the end of its long journey and it was deposited in the Hooker building at Pasadena, but upon being unpacked it was immediately seen

*Annual Report, 1907, of Prof. George E. Hale, Director of the Mount Wilson Solar Observatory of the Carnegie Institution of Washington.

that the lens was imperfect and did not fulfill the conditions of the order. Mr. G. W. Ritchey has been instructed to proceed at once to France and secure the casting of a perfect disk at the earliest time possible. It is hoped that this will be accomplished in a few months so that the grinding and polishing may be commenced by Spring.

This work and the five small accessory mirrors with the manufacture of the driving clock and the designs for the mounting, the steel dome and the building will be done by Mr. Ritchey and will require about three years. The cost of the optical parts will consume Mr. Hooker's Fifty thousand Dollars and it is estimated that the expense of the mounting, dome and building will amount to several hundred thousands of dollars.

Telescopes serve the Astronomer in a two-fold manner: First by their mighty power for gathering light. The unaided eye receives from an object as many rays as fall upon the pupil, which, under normal conditions, is about one-fifth of an inch in diameter. The object glass of a telescope serves as a pupil of larger dimension, and as many rays as fall upon it are carried to the retina of the eye. The increase in light-gathering capacity is in the ratio of the square of the diameter of the object glass to the square of the diameter of the pupil of the eye, and with an hundred-inch speculum, stars which are beyond the vision, not only of the naked eye, but even imperceptible through powerful telescopes, would become visible.

The second function of a telescope is to magnify the image at the focus. Galileo's telescope brought Jupiter's satellites 33 times nearer to his vision. It is difficult to state what magnifying power an hundred-inch mirror will allow, so much depends upon the "seeing" in using light-gatherers of large dimensions. A conservative estimate would probably be from fifteen hundred to two thousand diameters.

Wanted

Any numbers of Volumes III, IV, V, and VI of the Bulletin, particularly Numbers 4, 6 and 8 of Volume III, Number 5 of Volume IV, and the Index of Volume V.

We shall be greatly obliged to members who will send to the Secretary any of these numbers, as they will enable him to complete sets which are in demand.

The whole of Volumes I or II will be cheerfully exchanged for No. 6 of Volume III, or No. 5 of Volume IV. Send them to the office of the Secretary, 625 San Fernando Building.

Observations on the Teeth of Pueblo and Cliff Dwellers

By Dr. F. M. Palmer.

During the seasons, 1905-6, it was my privilege to make an examination and exploration of certain pre-historic ruins characteristic of the great plateau country lying in the southwestern part of the United States.

As a result of these researches, observations were made and opinions tentatively formed, that may, possibly, be held of value as supplemental to what has previously been recorded.

An investigator in this field is at once impressed by certain features characterizing the skeletal remains of its ancient inhabitants.

His attention is first arrested by noting a pronounced abnormality, in form, of the crania—a malformation produced by an artificial flattening of the occiput. The prevalence of marked lesions, and irregularity in arrangement of the teeth, also differentiate the remains of these people from similar remains of other races by whom they were surrounded.

The condition of these organs challenge attention, and invite investigation as to probable cause.

I propose to briefly discuss these conditions. Before doing so, however, I invite your attention, for a moment, to a consideration of the topographical features of the country in which these explorations were made, and to the civilization evolved by the ancient Pueblo and Cliff dwellers.

The bibliography treating of these subjects has dealt with them so exhaustively that an epitomized statement will answer the purpose of this discussion.

A territory of more than 150,000 square miles constitutes the area of occupancy by the people we are considering. It is very largely of forbidding aspect, except to those who love nature best when face to face with its wildest presentation.

The most conspicuous features of the landscape are rugged and blackened mountain ranges, measureless stretches of blistering yellow sand, barren mesas, appalling chasms, and stupendous cliffs of fantastically colored sandstone.

Devastating winds, torrential rains and cloudbursts, seismic shocks and volcanic eruptions, have here wrought upon the earth's crust an imperishable record of their power.

The forestation of its mountains, a sheltered nook here and there in its cañons, an occasional valley redeemed by the vivifying influence of spring, or mountain stream, is all that

does, or ever did, make this country possible as a home for man.

Here, however, was evolved a culture which manifested itself architecturally in many-storied buildings, constructed of rudely squared blocks of stone, laid in mortar composed of sand and clay.

Frequently these buildings—outside and in—were plastered. Interiors were often, and exteriors sometimes, given a coat of whitewash over the plastering.

It was here that—within the limits of the United States—fictile and textile art were brought into their highest expression by primitive man.

Culinary operations were conducted within the buildings, in rooms set apart for that purpose.

Fireplaces made of squared slabs of stone were built against the wall, or in the corner of a room. In some of the larger and better constructed buildings, however, I found in the center of the rooms what were, practically, box-stoves, or ranges. Three slabs of sandstone were wrought to equal dimensions, about 6 dm. in length and 4 dm. in width. One of these slabs was laid upon the stone floor in the center of the room, the remaining two were placed on edge by its sides, a shorter slab, but equal in height to the sides, was placed across one end, the other end being left open. These slabs were securely held in proper position by clay that, while moist, was plastered over and banked up around them on the outside.

The top was made of a slab somewhat shorter than the sides. A circular hole, 15 to 18 cm. in diameter, was wrought in the center of the slab. This hole, over which a cooking pot was placed during culinary operations, facilitated the cooking of its contents, exactly as do the holes in the top of a modern range.

A proper draft was secured by the front of the stove being left open, while the removable top could be pushed forward or back, as was required for leaving a suitable opening for the escape of smoke.

That, however, which primarily distinguishes the culture of these people is the skillful engineering displayed in establishing grades and levels for canals, ditches, and reservoirs, made necessary by their system of irrigating land for agricultural purposes.

I have personal knowledge that, in many instances, the grades and levels of these ancient canals have been—without alteration—incorporated in plans of modern engineers.

Investigation has disclosed that these people were possessed of a sufficient supply of suitable foodstuffs. Cultivation of the soil gave them corn, squashes, pumpkins and beans in abundance. They had domesticated the wild turkey, and possibly deer and rabbits.

Their cooked meats and vegetables were made palatable by a seasoning of salt.

They were abundantly supplied with fruits, berries and nuts, indigenous to this region.

A sufficiency of water was easily obtained.

Their lives were passed in an atmosphere invigorating and free from taint.

And, finally, their environment and culture were such as made necessary a reasonable amount of physical exercise.

I have dwelt on this phase of my subject at some length, as I desire to show that these people were possessed of all essential factors for producing a physically perfect race of men.

I now ask your consideration of the teeth of an adult Pueblo dweller.

With exception of the superior left lateral incisor, all the permanent teeth are present.

Referring to the superior maxillary, there is noted a space five mm. in width between the right lateral incisor and the first bi-cuspid. The cuspid which should occupy this space, has been crowded out of the arch, and is seen with its lingual surface resting equally upon the buccal surfaces of the bi-cuspids.

The permanence of this space, and the abnormal position of the cuspid, is doubtless due to the elimination of the temporary cuspid having been retarded until after all the permanent teeth were fully erupted.

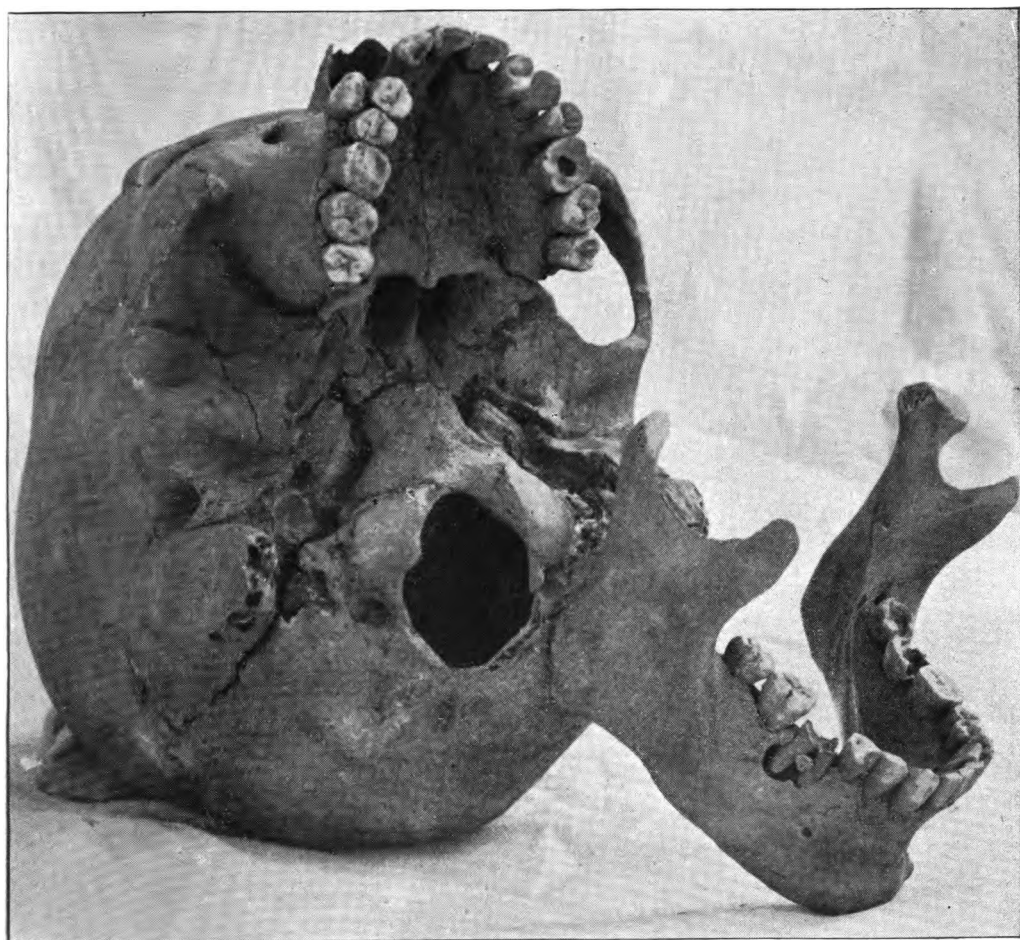
The position in the arch that should be occupied by the missing left lateral incisor is filled by the first bi-cuspid, while the normal position of the bi-cuspid is occupied by the cuspid.

There is nothing to indicate that the missing lateral was ever erupted. Neither is it present in any part of the maxillary bone.

It is stated in Harris' "Principles and Practice of Dentistry" that transposition of tooth germs sometimes occurs. Cases are cited in which the germs of lateral and central incisors were transposed. Other cases involve the lateral incisors and the cuspids. I have, however, been unable to find any record of transposition of germs of the cuspid and bi-cuspid, as is seen in this case.

Non-development of teeth is not of such rare occurrence as to be of special interest. Investigation will usually disclose the abnormality to have been hereditarily transmitted.

In the authority previously quoted, Dr. George Watt, an eminent American dentist, states that he had knowledge of "a family in which its female members for four generations lacked the left superior lateral incisor."



Skull of Cliff Dweller. Cañon De Chelly, Arizona Territory.

The molar teeth of the inferior maxillary present extensive lesions resulting from caries.

The major portion of the grinding, and distal surfaces of the left third molar, are affected.

Destruction of tooth substance is more pronounced in the left second molar. The entire grinding, and greater part of the mesial, distal and buccal surfaces are involved. A large opening into the pulp chamber establishes exposure and de-vitalization of the pulp.

The crown of the first right molar is entirely destroyed. Exposure, devitalization and suppuration of the pulp necessarily followed.

The necrosed roots still remaining in their sockets, and visible through openings (resulting from absorption) in the plates of the process, tell the story of alveolar abscess, and supply the climax in the destruction of this organ.

The conditions presented by the teeth under consideration are undoubtedly due to the same causes that are impairing the usefulness and durability of the teeth of the most advanced races of today. Briefly stated, these causes are a lack of thorough mastication of food, and the baneful influence of transmission of physical deterioration by heredity.

As I have previously stated, the Pueblo and Cliff dwellers possessed a varied and abundant food supply.

The number of clay cooking-pots, cracked, warped and blackened by smoke, which have been taken from their houses and cemeteries, and the rarity of baking-stones, makes it clear that it was their custom to boil rather than to roast or bake their food.

It may, I believe, be safely assumed that the greater part of their diet consisted of corn, squash, beans and possibly other vegetables that (while green) were cooked by being boiled.

The corn after maturing was ground into meal, when, as evidenced by remains in some of the cooking-pots, it was made into mush or porridge.

Stews consisting of meat and vegetables were, no doubt, prepared in the same manner.

It is clear that food prepared as is here indicated would probably receive but little mastication. Deterioration of the teeth would necessarily ensue.

In support of this conclusion, I quote from a work entitled, "The Cause and Prevention of Decay in Teeth," by Dr. J. Sim Wallace, a distinguished dental surgeon of England, and will add that, as a result of my own observations during thirty-six years devoted to the practice of dentistry, I unqualifiedly endorse the statements of Dr. Wallace. Furthermore, I believe that similar views are held by a majority of advanced members of the dental profession. Dr. Wallace writes:

"In the early periods of man's existence there was little social cohesion, and each individual had, to a great extent, to concern himself with securing food, and, when he had the opportunity or inclination, with cooking it.

"When we compare such a state of affairs with the various methods of securing food at the present day, and the elaborate machinery (flour mills, rice mills, sausage mills, sugar refineries, meat juice factories, etc.,) by which many of the foods are refined, not to speak of the processes to which foods are sub-

jected in our bakehouses, biscuit factories and kitchens, we see that there is some difference in the food of the present day from that in past ages. It may be said, however, that after all the foodstuffs have not essentially altered. We require proteids, carbo-hydrates, fats, water and mineral matter much in the same proportion as our ancestors, and this is what we get.

“There is one change, however, which has gone on, and is at the present time going on, till it has reached a stage which is absolutely detrimental to the well-being of the teeth, stomach, alimentary tract and body generally. There is a gradual elimination of all the coarse, fibrous, inert and undissolved earthy matters which are present, more or less, in the food of savages. The muscles of the jaw are not generally used as much today as when food was more difficult to get, and so the nerves of the teeth and the entire bony structure are not usually as well nourished as formerly.

“Another effect produced by the elimination of the coarse and fibrous parts of many foodstuffs is to encourage the habit of swallowing the food without much mastication.

“There are, I believe, many people who are so accustomed to eating food that requires little chewing that they often swallow food unchewed, which otherwise would be subjected to a certain amount of mastication. Of course, in such cases decay of the teeth is liable to be more frequent.”

This statement is of importance to this discussion, as, when followed to its logical conclusion, it appears to demonstrate that the teeth of man are adversely affected by the refinements of civilization. Furthermore, it may safely be assumed that defective organization, impairment of function, and premature loss of these organs, would keep exact pace with cultural advancement from a state of nature (savagery) to one of advanced civilization. And this is exactly true of races inhabiting the earth today.

The influence of heredity in transmitting physical characteristics is also to be considered. Persistence in transmission is conclusive evidence that, for a long period of time, successive generations had existed in an unchanged cultural environment.

If these conclusions are correct, it follows that the teeth constitute an index by which the degree and duration of the civilization of pre-historic races may be comparatively measured.

Our Food Fishes

By Prof. J. Z. Gilbert.

The Flounder Family.

“Flat as a flounder” expresses the distinctive character of this family of fishes. The adults are colored on one side, and plain on the other. They swim upon the plain side and both eyes are upon the colored one. The young, though flat, have both sides alike, and swim upright in the water, and have one eye on each side of the head. This last feature changes during growth by the one eye of one side moving around with the twisting of the skull or through to the other side. All have teeth.

There are three tribes of this family, the Halibuts, the Flounders, and the Turbots. In the first two the ventral fins are symmetrical and alike, while in the last they are unsymmetrical, and the one on the one-eyed side extends along the ridge of the abdomen. The Halibuts are recognized by their mouth, it being symmetrically developed and having teeth on both sides, while the Flounders have an unsymmetrical mouth and the teeth are chiefly upon the blind side, while the eyes and color are upon the right, thus “right handed.” The Turbots have the eyes and color upon the left, hence “left handed.” In the Halibuts these may occur upon either side.

The most valuable of these for food are: Common Halibut, *Hippoglossus hippoglossus*, Linn; Jordan “Sole” Flounder, *Eopsetta jordani*; Pacific “Sole,” *Psettichthys melanostictus*; Monterey or Bastard Halibut, *Paralichthys californicus*; Great or Starry Flounder, *Platichthys stellatus*.

The Common Halibut.

This very common fish is found not only in our waters from San Francisco north, but is found also on both sides of the Atlantic from about 40 north to Iceland and Greenland, as well as north of the English channel.

It attains a great size, equaling that of the tuna, and single individuals weighing over 700 pounds have been taken. The average fish marketed seldom exceeds six or eight pounds.

The temperature enjoyed best is a very cold one, being even as low as freezing, hence these fishes are taken in northern waters or at the greater depths, where they are often associated with the Cod.

This family are quite voracious eaters, gathering as they go their regular meal of crabs, mollusks and fish, and often scraps of debris, pieces of wood, iron, pebbles, lost jewelry, etc. They kill their prey by striking it with their powerful

tails, or by crushing it between their strong jaws. They themselves become a delicate meal for seals, whales and sharks.

The flesh of the ordinary size is generally firm, white, and of a delicate flavor, the female being preferred, while that of the larger ones is dry, coarse and unsavory.

The supply from the Pacific is enormous, which is said in the late years to exceed seven million pounds, with a value of over two hundred thousand dollars.

The time of spawning varies with species, this one spawning in the spring months. The supply of eggs is enormous; one species of the Atlantic weighing 200 pounds, produced over 2,000,000 eggs.

The Jordan "Sole" Flounder.

This member of the halibut tribe is a favorite of the Chinamen, who dry them in great numbers, suspending them by strings fastened to frames placed on the roofs of their houses. There they may be seen dangling and flapping in the breeze.

This is one of the finest food fishes of the group, and reaches an average weight of three or four pounds.

The dorsal fin has fewer than 95 rays, and the anal fewer than 75.

The lateral line has no anterior arch, and a double row of teeth occurs in the upper jaw; adherent scales in the lateral line, 96.

"The Pacific "Sole," "Local Sole," "Deep Sea Sole."

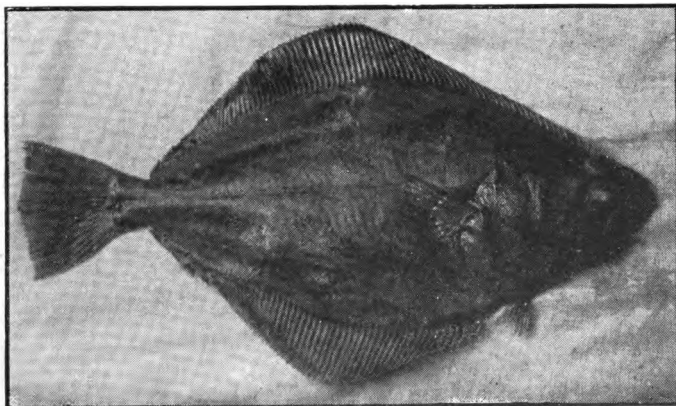


Plate I, Figure 2.

This very common flounder occurs from the Monterey Bay to Sitka.

It weighs on an average about three pounds. It is always

found in the markets, and is regarded as a fine food fish. This species may be distinguished from the last by its single row of teeth in the upper jaw, and the lateral line having an accessory dorsal branch.

The Monterey or Bastard Halibut.

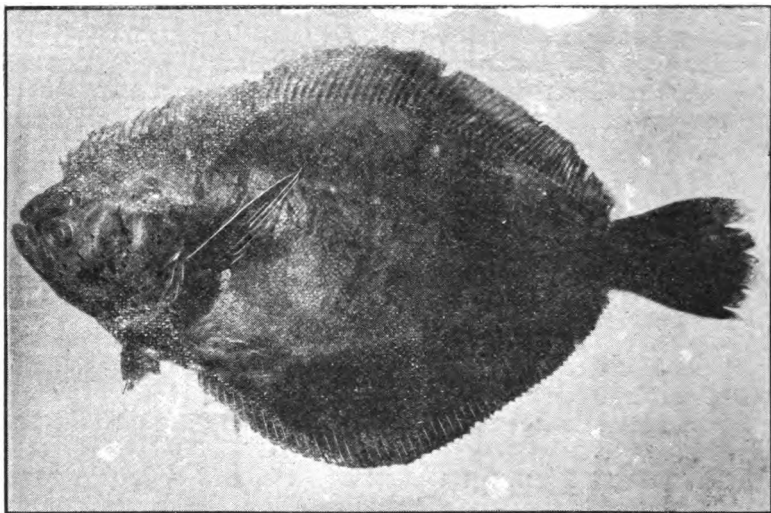


Plate I, Figure 1.

This is a very large species, attaining a length of four feet and a weight of 60 to 70 pounds. Although the flesh of the larger ones is coarse and tough and that of the younger ones is inferior to that of the Pacific sole, yet this fish abounds in the markets because of its beautiful flesh and fine "cuts," and at the same time answers very well the general demand for quality.

This fish differs from the Pacific sole in having a lateral line with an anterior arch.

The Starry Flounder.

This true flounder is "left handed," that is, it has the color and eyes upon the left side, instead of on the right, as is usual with the flounders. It is readily recognized by its bands of black in the fins, the regularly banded margins and wavy lateral line, and the general surface irregularly but thickly spangled with starry spots or tubercles among which darkened blotches more or less faintly appear. This fish amid the tints and shadows of the sea is not readily recognized, but when viewed in proper lights and at right angles it becomes a thing of charming beauty.

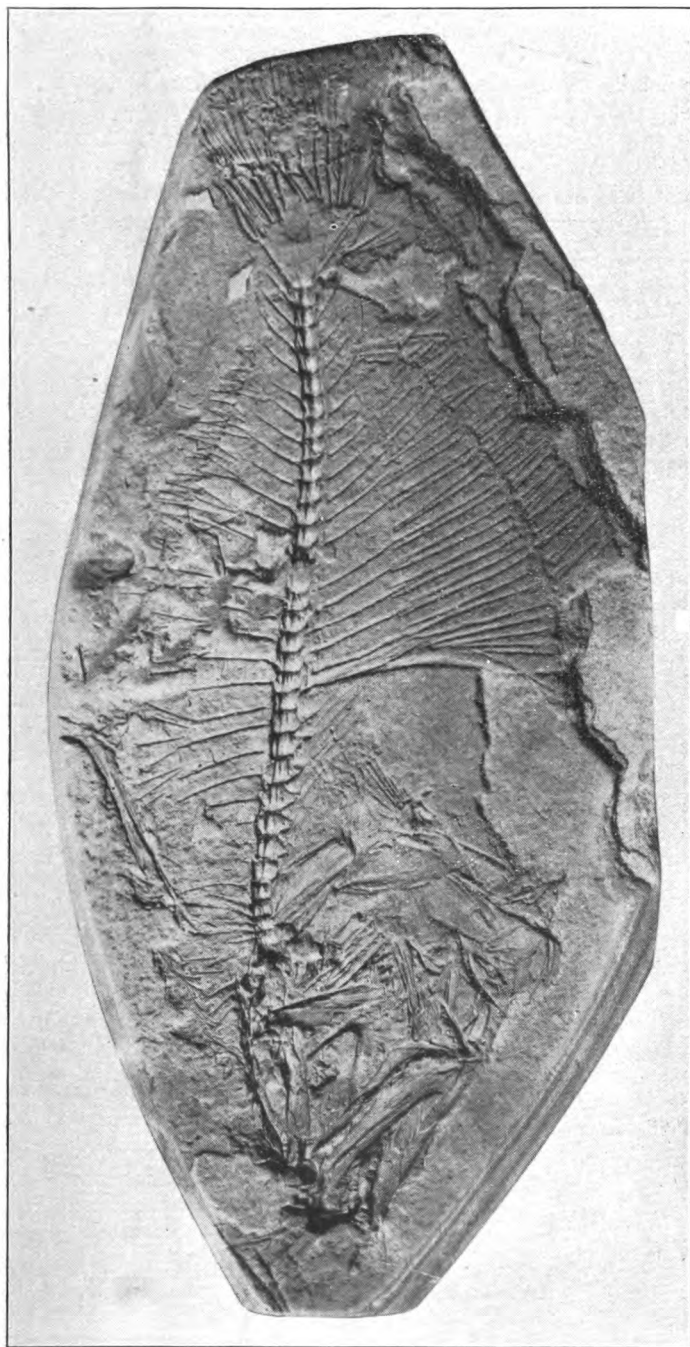


PLATE II.

Fossil Flounder imprint found by workmen of the **Magne-Silica Co.**, Los Angeles, near Lompoc, in the **Miocene** formation.

It is a most excellent food fish, the flesh being tender, savory and delicious. It occurs in abundance from San Francisco north, and along the Asiatic coast. Being a shallow water fish, it often appears in the estuaries and in the rivers.

It is not a large fish, its average weight being about 10 to 12 pounds, yet it furnishes about fifty per cent. of the total flounders taken.

The flounders are said to be quite gamy, affording no little sport in the landing of the larger specimens. Their bite is the slightest nibbles, then a start, a rush, a darting to and fro, then heavy surging in its efforts to escape characterize the conduct of the "sockdolliger" of the Atlantic.

A Fossil Flounder.

Preliminary Notes. Part I. To be named in my next paper.

Fossil specimens of the flounder are very rare, and to find one such as is figured here is a very pleasant surprise. This specimen was found near Lompoc, Santa Barbara county, in the diatomaceous earth of the Miocene formation.*

This was a fish greatly compressed, having eyes and color upon the right side, the dorsal fin continuing from in front of the eyes to near the caudal, and a corresponding ventral fin. Only an imprint of the fish remained to tell its story.

This interesting specimen presents quite a number of features which place it as an earlier branch of the tree of animal development than that of the halibuts and flounders. Indeed, there are strong suggestions that this is a generalized type from which these two have sprung and thus forms a connecting link between them and lower forms.

If Miocene formation is the proper designation for the diatomaceous rocks in which this fish was found, then while the shales upon which much of Los Angeles rests were forming in the sea, the fishes of this type, the best flounders to this time, were swimming over the diatomaceous beds forming in the sea over Santa Barbara county. The undisturbed condition of the skeleton, and the total removal of osseous substance leaving a hollow cast in the ooze, suggest a deep-sea fish, or that the fish suddenly dropping to the bottom was buried in the ooze and gradually destroyed by the living forms whose skeletons, in turn, made the casket of our fossil.

*Fossil by the kindness of the Magne-Silica Co.

Startling Phases of a Great Comet

By Wm. H. Knight.

The great Comet Morehouse (1908 c), which arrived at perihelion on Christmas day, 1908, is, in the language of Astronomer Barnard of the Yerkes Observatory, "the most bizarre comet that we have had to deal with since photography began to register the freaks of the tails of comets. Almost nightly it has shown features that would have singled it out as a very remarkable object, and on more than one occasion it has presented a most extraordinary and unique appearance."

It is now swinging round the sun in a great parabolic curve, having arrived from mid-heaven above the plane of the earth's orbit, and plunged through that plane to the mid-heaven below, at an angle of 140 degrees; consequently its motion round the sun is retrograde, or contrary to that of the earth.

At its perihelion passage (point nearest to the sun) on the 25th of December, the comet was barely 5,000,000 miles within the earth's orbit, as shown in the accompanying diagram, but the earth on that date was at the opposite extremity of its orbit, or about 180,000,000 miles distant from the comet.

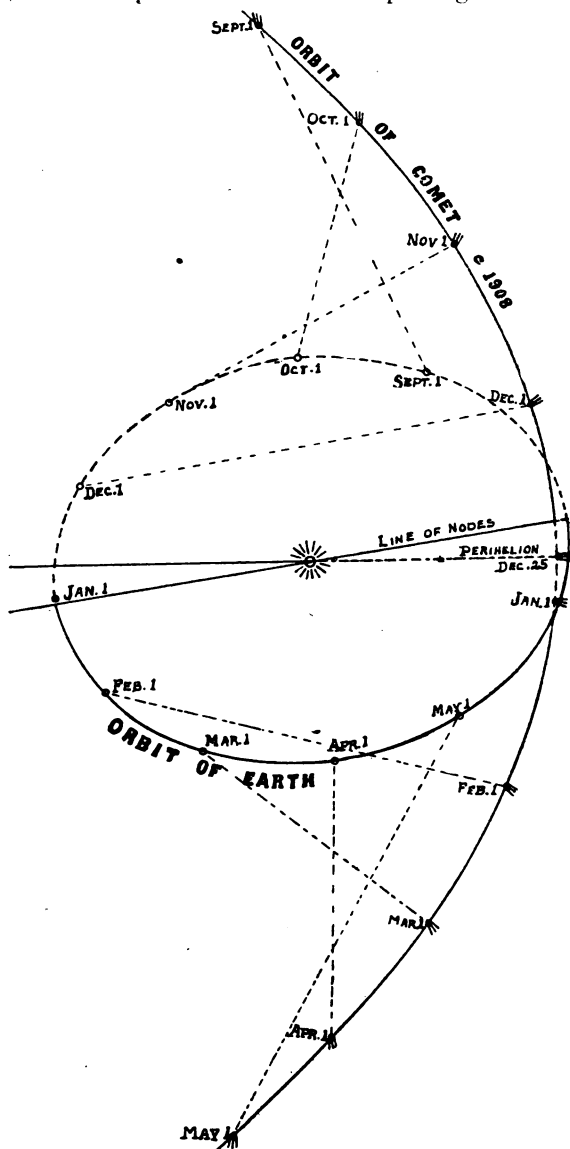
Suppose the great comet had arrived at the same point six months earlier, we should then have beheld this enormous but loosely aggregated mass of matter, partly self-luminous, and having a diameter about one-third that of the sun, at such close range that we could readily observe the violent disturbances going on within its brilliant nucleus, and it would have formed an important epoch in astronomical research.

Its mysterious tail, an appendage streaming out into space for a distance of 27,000,000 miles, would have completely enveloped the earth, and would possibly have introduced some noxious elements into our atmosphere, though under such extreme dilution as to be quite harmless. It is asserted that the earth plunged through the tail of a great comet which suddenly flamed across the northern sky in 1861, and that the only noticeable effect was a slightly roseate hue in the atmosphere.

When the Morehouse comet was first seen by its discoverer, September 1, 1908, it was 140,000,000 miles away, but while it was approaching, the earth was moving in an opposite direction, and during the month of October the two bodies were but little more than 100,000,000 miles apart. On account, however, of the high declination of the comet, within thirty degrees of the celestial north pole, it could be observed from sunset to sunrise.

These opportunities were so well availed of in some

observatories that many photographs of this object were taken by different observers during the same night. Prof. Barnard made no less than 239 photographs on forty-seven nights, thus enabling him to note the changes in the form and brightness of the tail, not only from night to night, but also from hour to hour, and many of these were surprising.



Orbit of the Morehouse Comet (1908 c.)
(Diagram reproduced from "Popular Astronomy.")

Before proceeding to narrate some of the marvelous transformations which his sensitive films recorded, it may be well to state certain theories now held regarding the formation of a comet's tail. The researches of Arrhenius and the experiments of Nichols show that the repulsive force which drives the exceedingly minute particles from the comet is due to the pressure of light—the impact of the sun's rays. These infinitesimal particles, though so numerous as to form a gossamer trail of light behind the comet, are yet of such extreme tenuity that faint stars can be seen through clouds of them which are thousands of miles in thickness. But these trails of light are subject to remarkable distortions, deflections and curvatures in form, and also to sudden and frequent changes in brilliancy, probably due to other causes than light pressure, perhaps electrical.

As an example of the capricious behavior of the Morehouse comet, on the 14th and 15th of October it was faintly visible to the naked eye; on the 17th it was not thus visible; but in the latter part of the month it grew so bright that on the 29th it was pronounced very conspicuous, with a tail which could be traced for five or six degrees. On the very next night, October 30th, it was comparatively faint.

On the 14th of October, Mr. Miller at Swarthmore, making telescopic observations, noticed two condensations or luminous masses in the tail. On the following night he found that they had been moving rapidly from the comet's head. In the course of two and a half hours one of these condensations moved 224,000 miles, and the other 247,000 miles. A comparison of positions for twenty-four hours showed that their average velocity was 129,000 and 142,000 miles per hour, respectively.

On the 30th of September, while Director Wilson of the Goodsell Observatory was photographing the comet, its tail, then telescopically eight degrees in length, apparently detached itself from the head. On the next night the bright portion of the tail was two degrees from the comet's head, showing a rapid movement of the luminous mass during the previous twenty-four hours.

Another account mentions a similar occurrence, a narrow streamer ran out from directly behind the nucleus, and this was barely visible in the telescope, but about 45 minutes (three-fourths of a degree) from the head, the tail suddenly brightened and broadened out to a width of 20 minutes, and from this point broadened out still more and curved to the rearward of the comet's motion. These rapid transformations of the tail have not been paralleled in comet observations hitherto. They form interesting studies which are calculated to throw much light on the nature and constitution of these strange heavenly bodies.

Regarding the spectroscopic investigations of the Morehouse comet, a singular fact has been brought out. Pluvenal of the Juvisy Observatory finds that the spectrum displays the absence of the hydrocarbons, which were a feature of Daniel's comet, that attracted so much attention in 1907, whilst the complete system of cyanogen spectrum is represented. Probably this significant fact accounts for Barnard's observation that while the light of the Morehouse comet is fainter than that of Daniel's, its photographing power is much stronger.

After passing around the sun, Comet Morehouse will be seen only in the southern hemisphere, where it will be a telescopic object for several months. The astronomers in that part of the world are eagerly awaiting its appearance. The latest computed elements of the comet are as follows:

Perihelion passage, December 25.8, 1908.

Inclination of orbit, 140 deg. 10 min.

Distance from sun, 0.94554.

The perihelion distance is accordingly about 88,000,000 miles.

The comet is now moving rapidly away from the sun, but will be followed by the telescope for several months. As the congealed gases which have been fused and awakened into activity by the sun's heat become again frozen by the zero cold of interstellar space, the luminous appendage will continually grow shorter and fainter till it entirely disappears, and nothing will be visible but the faint, nebulous disk of the comet's head, till the retreating comet is lost even to telescopic sight.

We have referred to the orbit as parabolic. If it is such it will pass beyond the control of our sun's attraction, and after the lapse of some millions of years enter the sphere of influence of some other stellar body, and after further untold ages will flash its weird lights through the skies of some other circling planet, and give rise to speculations regarding its past history and journeyings through the infinite void.

On the other hand, further and more precise data may show that its orbit is elliptical, in which event, after traversing a path which will carry it thousands of millions of miles beyond the orbit of Neptune, it will move very slowly around its aphelion curve, and then be drawn again toward the sun. After the lapse of untold ages, perhaps many, many thousands of years, it will again revisit our midnight skies and repeat the phenomenal transformations of nucleus, coma and tail which have recently excited so much interest among astronomers and laymen. With what order of intelligence and with what kind of instruments will it then be observed by the denizens of earth?

The Astronomical Observatory at Vienna, Austria

By Holdridge Ozro Collins, LL. D.



The largest Building of the Vienna University, containing the Library, Lecture-rooms, Exhibition-halls, Administration-offices and Promenade-Colonnades at the junction of University street, Franzensring and Schottenring.

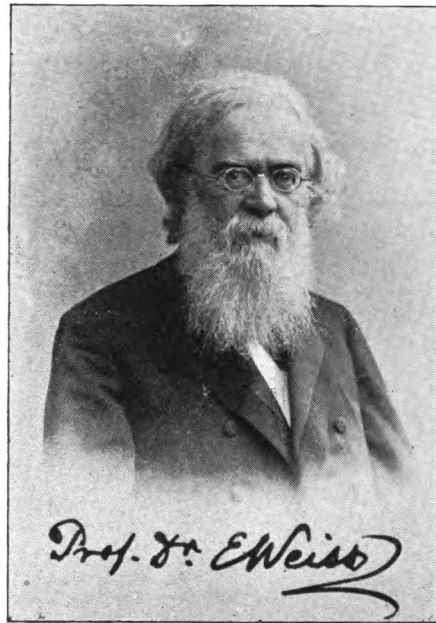
It has been my happy fortune to pass the winter of 1907-1908 in Vienna, and the most pleasant of the many agreeable events of my experience in that lively city were my reception by Professor Weiss and the facilities afforded by him for inspecting the great Observatory, of which he is Director, and an examination of the work carried on under his control.

My only credential was my Certificate of Fellowship in The Southern California Academy of Sciences, but it proved an open sesame to a most cordial and more than friendly reception.

Edmund Weiss is a Doctor and Professor of the Vienna University, and he has also the high dignity of Hofrat, or Imperial Counsellor, an honor conferred only by the Emperor, who has for him the greatest esteem, and he had the most friendly relations with the late Empress Elizabeth.

He is a gentleman of medium stature, with brilliant black eyes and a snowy mane and beard of Jovian proportions; and although seventy years old, he has the vigor and vivacity of a man of fifty.

In the several interviews I have had with him, I have appreciated his cordiality and his evident desire that I should



dispossess myself of any thought that I was trespassing upon his time or good nature.

He was much interested in what I told him of the observatories now erected and in process of construction upon Mts. Wilson and Lowe, near Los Angeles, California, and he expressed the warmest admiration for the generous gift of Mr. John D. Hooker, with a sigh of regret that Vienna had no such public-spirited citizen to present and endow a similar Reflector in this place.

He is familiar with the work of Pickering, Lowell, Campbell, Perrine, Holden, Burnham, Hall, and others of our Astronomers, some of whom he has met.

In 1872 he was sent to America to examine the large instruments there in operation, and to investigate the conditions of our work and our rapid progress in Astronomy, which were attracting much attention in Europe.

He passed considerable time at the Harvard University Observatory, and the result of his investigations was the adoption by the Austrian Government of his recommendations; and the present noble Observatory in Vienna was commenced upon plans under his suggestions, while Karl von Littrow, his predecessor, was director. Soon after its completion, an objective of 11 3/4 inches with 17 feet focal length, made by Alvan Clark

of Cambridge, was placed upon its lofty pier in the West Dome.

His staff consists of three observers or adjuncts, and two assistants, young men who have adopted the science as their life-work, and who stand in line for promotion.

The Professor commenced his career in 1858 as assistant. In 1862 he became an observer or adjunct, and in 1877, upon the death of Karl von Littrow, he was appointed Director.

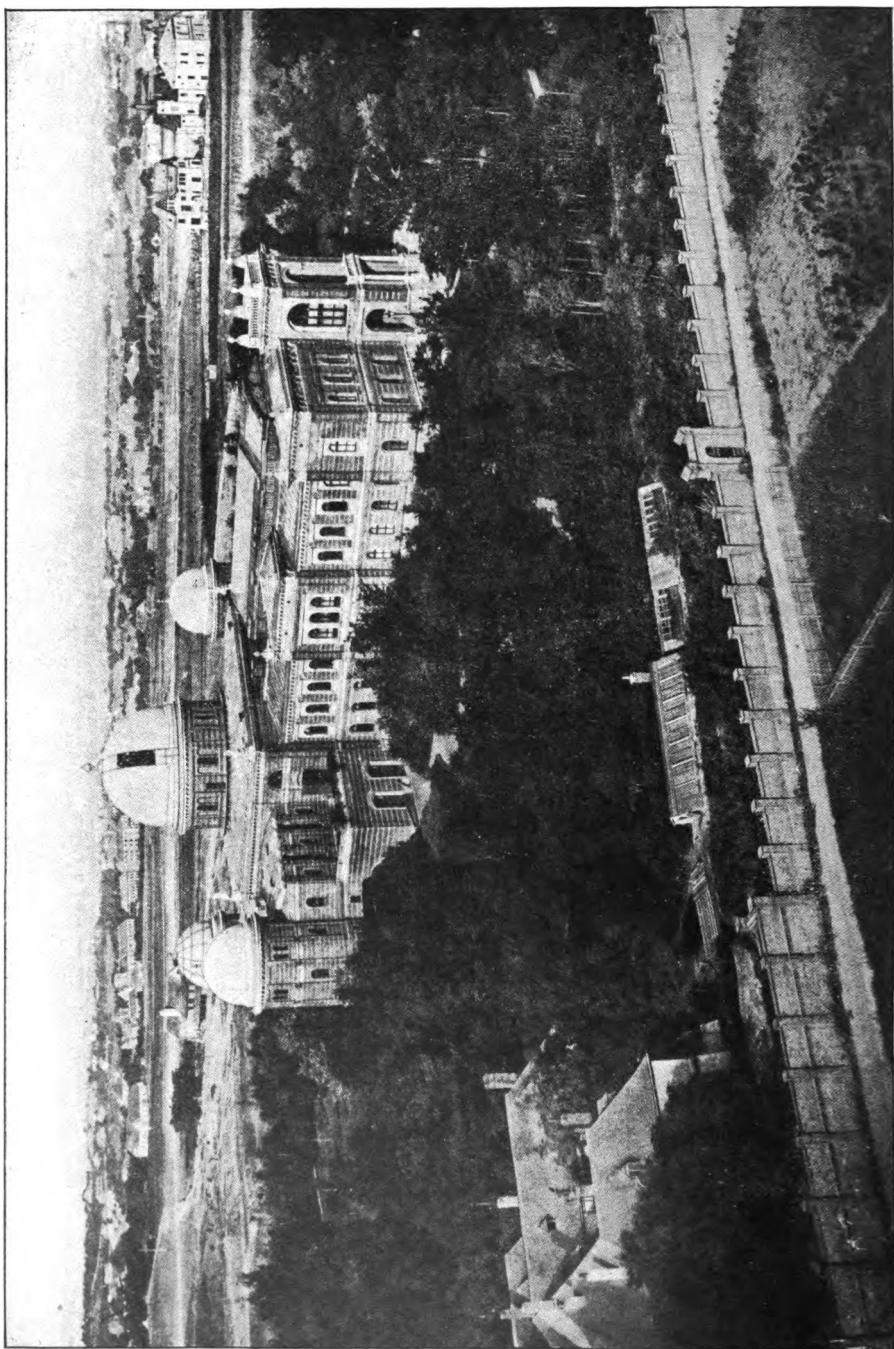
In 1756 the Vienna University had acquired renown throughout Europe by reason of its advanced educational facilities, particularly in the sciences. At this time Father Maximilian Hell, a Jesuit, was Professor of the Astronomical Section, the first to hold that rank, and the reputation he acquired by his lectures and observations induced the King of Denmark in 1769 to send him to the North Cape for the observation of the transit of Venus. He commenced the publication of the "*Ephemerides Astronomicae ad Meridianum Vindobonensem*" (Astronomical Memoranda at the Vienna Meridan), with a Nautical Almanac and observations of other astronomers. This publication was continued during the period from 1757 to 1786. In 1819 Joseph John Littrow, the Director, instituted the *Annalen*, which is practically a continuation of the *Ephemerides*, and this publication has been continued by his son and successor, Karl von Littrow (who was ennobled), and Professor Weiss down to the present time.

The original home of the Observatory was in the old University Building at University Place in the very heart of the city, a spacious and beautifully decorated structure, erected by Maria Theresia, where it remained until 1880.

In the great uprising of the people of Vienna in 1848, against the repressions of the Church, the brutal conduct of the police and the censorship over almost every act of the citizens, under the tyranny of the Metternich administration, the students of the University were the leaders and prominent factors.

After the capture of the city by the Imperial forces, as a punishment for their course, the students were driven from their building, and it was turned over to the army authorities for barracks. It was used for this purpose until 1857, when the soldiers were sent to other quarters and the home of the University was given to the Academy of Sciences.

During this period, while the various departments of the University were dispersed around the city, carrying on their work in such quarters as could be obtained, the Observatory was allowed to remain in its old quarters, although the work by its Professors and students was hampered by the most annoying interruptions and interference by the soldiers in possession of the premises.



The Astronomical Observatory, Turkenschanze Heights, Vienna, Austria.

The great advances in educational facilities and the rapid institutions of new Universities and Colleges throughout the other countries of Europe and in America, became an object lesson, not only to the people of Vienna, but to all Austria. The University was without a home and many of its departments had no regular place for work, lectures being delivered even in private houses, and the quarters occupied by the Observatory in the old part of the city were unsuitable and entirely inadequate for its growing demands.

These conditions were repeatedly called to public attention and a general desire became manifest for radical amelioration in all departments of the University.

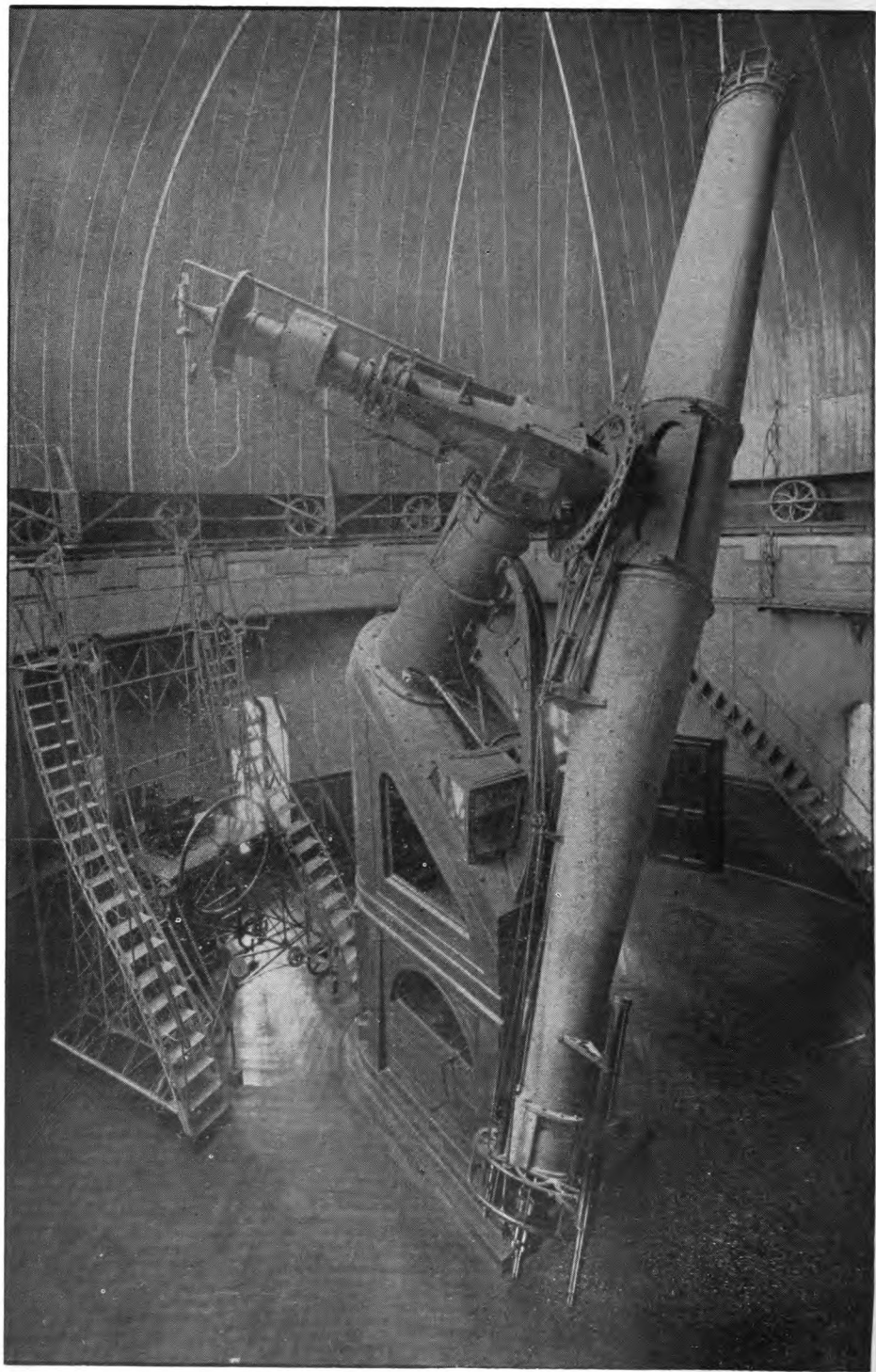
In 1872 Mr. Strehmayer, Minister of Education, a gentleman of liberal culture, broad ideas and a strenuous advocate for all improvements tending to the advancement of the higher education, obtained from the Parliament an appropriation for the purchase of a site for an Observatory, the erection of a suitable building and the securing of instruments and appliances of the latest designs.

The government paid for the tract selected, two hundred and fifty thousand crowns, equivalent to fifty thousand dollars. Its present value is not less than one hundred and seventy-five thousand dollars. It comprises a portion of the district called *Türkenschanze* (literally, the camping field of the Turks), upon which the Turkish army of over 200,000 men, under Kara Mustapha, was encamped during the famous siege of Vienna in 1683. The dirt wall of one of the Turkish redoubts, now covered with trees, partially surrounds the building occupied by the photographic instrument. The entire enclosure, embracing about sixteen and three-fifths (16 $\frac{3}{5}$) acres, is surrounded by a high ornate brick wall, with two artistic wrought-iron arched gateways.

In 1883 Emperor Francis Joseph I, formally placed the last stone of the noble edifice which now overlooks Vienna from the apex of the loftiest elevation in the Northwest portion of the city.

The cost of this structure was two million crowns (\$400,000). It is of brick, three hundred feet in length by two hundred and eight feet across the two wings, in the shape of a cross, with four domes.

The living rooms of the Director's family, his offices, the working rooms of the observers and assistants, and the Library are in that portion fronting south, which forms the foot of the cross. Entrance is under a spacious porch, into a fine hall lighted through a glass roof, at the east side of which is a marble tablet reciting:



The Twenty-seven inch Equatorial in the large Dome of the Observatory at Vienna, Austria.

“Erbaut
Unter
Sr. M. Des Kaisers
Franz Josef I.
1874-1880.”

(Erected under His Majesty the Emperor Francis Joseph I.
1874-1880.)

On the west side a tablet reads:

“Begonnen
Unter
Dir. Karl v. Littrow
Vollendet
Unter
Dir. Edmund Weiss
Nach den Plänen
der Architekten
Fellner & Helmer.”

(Commenced under Director Karl von Littrow, completed
under Director Edmund Weiss, according to the plans of the
Architects Fellner & Helmer.)

A pleasant flight of granite stairs leads to the main floor paved with mosaic, from which a hall conducts to the large circular room in the center of the cross, through which, from the solid rock, four metres below, ascends the massive pier upon which, under the great dome, forty feet in diameter, rests the objective of 27 inches, with a focal length of 30 feet. A stairway winds around the pier, reaching the observing floor.

This refractor was mounted by Grubb, and it was the first large instrument with which the vernier of the hour circle could be read from the eye end without the necessity of ascending to the axis of the tube for that purpose.

In the large circular hall, at the west of the pier, is placed the transit instrument, and in the dome at the west arm of the cross, is the Clark 11 3-4 objective.

The North dome, on the top of the cross, had for many years a comet seeker, but this has lately been removed and substituted by a short focus instrument for coarser photographic work of a general character.

The East dome contains the old six-inch equatorial which had done its work from the roof of the Academy of Sciences building. It was the largest instrument owned by the Observatory College prior to its removal to the present location.

In an alcove at the Southeast side of the large circular hall, are several smaller objectives, which can be easily moved to an adjacent exterior stone platform for use by the idle curious and others, when the larger glasses are not at disposal.

A smaller building in the Western part of the grounds contains an excellent instrument for photographic work of more precise definition.

The Observatory (or Sternwarte—in the national vernacular, meaning literally, waiting for the stars,) forms a department of the Vienna University, and theoretically, is subject to the same general governing authority that controls all the other departments; but, practically, it is independent and conducted entirely under the direction of Dr. Weiss.

Lectures by Professors Weiss and Hepperger are delivered at the University building on Franzensring during the first semester, upon the general principles or introduction to the study of astronomy, but throughout the second semester, instruction is given at the Observatory in practical work, the use of the instruments, observations and calculations.

The expenses are met by appropriations from the Parliament, which, however, are seldom large enough to meet the demands constantly arising by reason of the rapid advances in the science, more particularly in the lines of photography and astro-physics. When the present Observatory was completed, celestial photography was in its childhood; the spectrum had not yet been applied to the equatorial and the word astro-physics had not been coined. With the exception of the zone of the Asteroids, the discovery of a new body or of a double star was a rare event, and the instruments purchased were adapted for use on the lines of the older astronomy. Observatories were not then, as now, located all over the earth; the losing track of a celestial body was considered a serious matter, and, therefore, the principal work of this Observatory has been in observations of comets, the planets and the moon; in correcting old errors regarding nebulae; charting the positions and orbits of the planets, and the comparison of later observations with those of Herschel, with considerable attention to the double and variable stars.

Professor Weiss has long been desirous of having the facilities for celestial photography and astro-physics. He has sent his assistants to England and other places to acquire the necessary information and skill, and he has also labored with tongue and pen to obtain the instruments necessary for this work. But these are expensive, and the necessary funds have not been forthcoming, for so many demands are made upon the public treasury by the numerous institutions of learning, that the Minister of that department of the government who has such matters in his care, has not yet been able to secure from Parliament an appropriation sufficiently large to meet the wishes of Dr. Weiss, although during the last year an excellent photographic instrument was secured and placed in a new building erected West of the main structure.

The Library of the Observatory embraces about ten thousand volumes and between five and six thousand pamphlets, among which are many valuable calculations, observations and other documents from the fertile brain of Professor Weiss, during his long, illustrious and most honorable career.

Transactions of the Academy

JANUARY, 1908.

Owing to the unavoidable absence of the Secretary, the minutes of the January meeting were not preserved.

FEBRUARY, 1908.

At the regular meeting of the Academy, February 3rd, the topic for consideration was "Archeological Researches in the Southwest," and was presented in most attractive and instructive form by Dr. George La Monte Cole, a gentleman who has given many years of his life to this field of investigation, with systematic and intelligent thought. Dr. Cole is an enthusiast in his specialty, and communicates the same spirit to those to whom he speaks. His lecture was greatly enriched by stereopticon views of many of the most rare and interesting specimens of archeological study, confirming his statement relative to the extreme richness of this section of the country in tangible evidences of prehistoric man.

MARCH, 1908.

The evening of March 2nd was spent by the members of the Academy in imagination amid the wild grandeur and magnificence of the Sierra Nevada Mountains, under the leadership of Mr. Russ Avery, who recounted in eloquent terms the experiences of a party of young men on a vacation trip to the highest and roughest regions of this splendid mountain range. Aided by the stereopticon, scenery unsurpassed on any continent was brought home to the auditors with an enthusiasm that was contagious, and which thrilled all present with a sense of patriotic pride in the matchless grandeur of our mountains, valleys, streams, and forests. The exhilarating joys of outdoor exercise and the fascinating freedom of camp life formed a conspicuous feature of this instructive lecture.

The following Preambles and Resolutions were unanimously adopted, viz:

Whereas, the Southern California Academy of Sciences received some months ago, through Mr. Holdridge O. Collins, Secretary of the Astronomical Section, a valuable contribution from Professor Simon Sarasola, S. J., of the Observatory of Belen, at Havana, Cuba, entitled "Estudios sobre el nefelismo en la Habana," presenting the result of important observations made by Rev. Laurent Gangoiti, S. J., Director of the Belen Observatory, relating to cloud formations over the West India Islands, and predictions of disastrous storms, verified in a remarkable manner;

And, Whereas, the above contribution was duly translated into the English tongue and read before this body by Mr. William A. Spalding, former President of this Academy, an authority on meteorological phenomena, and favorably commented upon by him, now, therefore,

Be it Resolved, by the Southern California Academy of Sciences, in

regular session assembled, that the thanks of this Body be tendered to Professor Simon Sarasola, S. J., for his valuable contribution; and,

Resolved, further, that a copy of these Resolutions, together with a translation of his scientific paper, which was used, be forwarded to Professor Sarasola.

APRIL, 1908.

The subject of discussion on this evening was "The applications of Electricity," especially to wireless telegraphy, and was most fully and ably presented by Prof. Twining of the Polytechnic High School. The lecturer introduced his subject by a general discussion of the all-pervading ether which occupies space, affording the medium of transmission of waves of heat, light and electro-magnetism from one cosmic body to another. He claims that ether is without weight, weight being a condition and not a quality of matter. The difference between fundamental and harmonic waves in ether was well illustrated by vibrations of a rubber rope made to vibrate both as a whole and in sections at the same time. The characteristic differences that distinguish the various forces that are transmitted by ether are due to differences in wave length and in frequency.

The speaker described the various forms of transmitters, transformers, condensers and other electrical apparatus, to be used in his experiments, and then proceeded to demonstrate some of the most striking effects of high-frequency electricity. His illustration of the principles and methods involved in wireless telegraphy was most vivid and satisfactory, showing clearly the capacity of the atmosphere to transmit electro-magnetic waves that may be made by proper apparatus to subserve the interests of man in the communication of thought. It is worthy of mention that all of the apparatus used in the various experiments on this occasion was constructed by students in the scientific department of the Polytechnic High School.

MAY, 1908.

The Academy met in regular monthly session, the Secretary in the chair. After preliminary announcements for the guidance of the Academy, he introduced President B. R. Baumgardt, who proceeded to address the Academy on the "Overthrow and Reclamation of Pompeii." The speaker gave a vivid historical account of the conditions prevailing in the ancient city previous to the memorable catastrophe, and of the physical aspects of the then long extinct volcano of Vesuvius. He painted in glowing colors the dreadful magnificence of the scene as beheld by Pliny from Cape Misenum, when the great mountain belched forth flame and smoke and ashes, and lava, to the imminent peril of the cities upon its slope, and pictured the awful consternation that prevailed as Herculaneum and Pompeii were entombed by the overwhelming avalanche of lava in the one case and the rain of ashes in the other. He pointed out that this distinction in the cause of the overthrow has made the difference in the method and difficulty of reclaiming the two cities. Herculaneum having been overwhelmed by lava, is held in the grip of a glassy cement, as hard as flint, which must be chiseled away by a slow and tedious process; while Pompeii, having been enveloped by falling ashes, is readily exhumed by pick and shovel.

The speaker then unfolded to the view of the audience, by means of exquisite stereopticon slides, the strange yet fascinating scenes of this ancient center of Roman fashion and art and culture. The streets and houses, the frescoes and statuary, the domestic utensils and evidences of social refinement, were presented with striking naturalness, and described in terms so clear and direct as to place the auditors in imagina-

tion amid the very living activities of this historic spot of antiquity. The lecturer took occasion to exhibit slides that depicted the scenes of cruelty, tyranny and debauchery that have made the name of Caligula, Emperor of Rome, odious for all time to come. The lecture was replete with interest and information, and was received with marks of the highest appreciation.

At the close of the lecture the members proceeded with the annual election, and the following-named gentlemen were unanimously chosen as directors for the year ending June 30, 1909, viz:

Bernard R. Baumgardt, Melville Dozier, B. E. Beeman, John D. Hooker, F. D. Bullard, Samuel J. Keese, Holdridge O. Collins, William H. Knight, John S. Vosburg, William L. Watts, C. A. Whiting.

At the subsequent meeting of the directors the following officers were elected:

President—Bernard R. Baumgardt.

First Vice-President—William H. Knight.

Second Vice-President—John D. Hooker.

Treasurer—Samuel J. Keese.

Secretary—Holdridge O. Collins.

JUNE, 1908.

At the final monthly meeting of the Academy President Baumgardt presided and called for the report of the Secretary for the past year. The Secretary presented an abstract of the proceedings of the Academy during the year just closing, and his report was accepted by the Academy with thanks. The report of the Treasurer being called for, was presented in satisfactory form, showing a small balance on hand. The thanks of the Academy were presented to the Treasurer for his very efficient services during the year. The President announced the generous gift of one hundred dollars toward the current expenses of the Academy from Vice-President John D. Hooker.

He then gave a brief account of the progress being made by the Director of Mount Wilson Observatory, and his assistants, stating that the sixty-inch lens had been successfully transported to the mountain top and is being mounted for use. He also stated that the great one-hundred-inch lens donated by Mr. Jno. D. Hooker, has been successfully cast in Paris, and is now on its way to its final resting place on Mount Wilson. It will probably require two years to complete its polishing and mounting.

A paper by Holdridge O. Collins, Secretary of the Astronomical Section, upon the Astronomical Observatory at Vienna, and the work of Professor Edmund Weiss, was received with great attention. Mr. Collins is now sojourning in Vienna, and the courtesies extended to him by Prof. Weiss have enabled him to give a very interesting account of that great Observatory.

The lecturer of the Evening, Dr. Theodore B. Comstock, ex-president of the Academy, was then introduced, and delivered a most scholarly address on the "Music of Evolution." He went fully into the theory of the genesis of matter, endeavoring to demonstrate that as matter in its various combinations assumed the forms now extant, a certain law of development is traceable which bears a striking resemblance to the relation of the various notes in an octave of music.

Dr. Comstock's lecture evinced extensive research, and was highly technical, both in matter and composition. At the close of the lecture the Academy adjourned to assemble again the first Monday in October, 1908.

MELVILLE DOZIER, Secretary.

OCTOBER, 1908.

The general meeting of October 5, 1908, was called to order by the acting Secretary, who congratulated the Academy upon the propitious opening of the new academic year, and bespoke a generous support of the meetings of the Academy during the coming year.

Announcements of the monthly meetings of the several Sections were made by the chairmen of the respective Sections, the Biological Section being prepared to announce its entire program for the year, and the fact that its meetings during the coming year would be held in the rooms of the University Club, at 349 South Hill street.

The subject for consideration this evening was Lake Tahoe, its geological environment, some historic data, and its scenic charms.

An interesting address was delivered by Vice-President Knight, setting forth the history and geology of this magnificent sheet of water, filling a great basin in the midst of the highest and grandest of the Sierra Nevada Mountains, being twenty miles long, twelve miles wide, and 1700 feet deep. The scenic beauties of the place, ranking among the finest of the globe, were most charmingly portrayed by stereopticon views of surpassing loveliness. These views appealed both to the artistic sense and the patriotic pride of the audience, and were enjoyed to the utmost.

MELVILLE DOZIER, Acting Secretary.

NOVEMBER, 1908.

There was no meeting of the Academy in November.

A called meeting of the Directors was held at 4:30 o'clock P. M., on Friday, November 27, 1908, in the office of the Academy, room 625 San Fernando Building. All the Directors were present except Bullard, Vosburg and Dozier.

President Baumgardt announced the appointment of the following Committee on Publication, viz: Holdridge O. Collins, Chairman; Anstruther Davidson, William H. Knight.

It was ordered that hereafter the Bulletin be regularly issued in January and July.

Mr. Bruce Hatch and Prof. H. La V. Twining were elected members.

The Treasurer was authorized to rent quarters in the San Fernando Building for the permanent office of the Academy.

Hofrat Professor Doctor Edmund Weiss, Director of the Kaiserlich Koeniglich Sternwarte (Imperial Observatory) at Vienna, Austria, was unanimously elected an Honorary member of the Academy.

The Secretary was authorized to cause all complete sets of the Bulletin to be bound, and distributed to such scientific Bodies as he may select from the list of those desiring copies.

DECEMBER, 1908.

The December meeting of the Academy was held in Symphony Hall on the seventh of the month, President Baumgardt in the chair. Notice was given of the meeting of the Biological Section on December 14, and the Astronomical Section on December 21. The President announced the arrival at Pasadena of the casting for the lens of the Hooker 100-inch reflector.

In the discussions of the subjects for the evening, Dr. F. C. Mattison spoke upon Public Health Work, and he dwelt particularly upon the scientific application of methods for combating disease, particularly tuberculosis. The necessity for bringing home to the people, particularly the poorer classes, a perfect understanding of the gospel of cleanliness, and the precautions to be taken in the family to prevent the spread of contagious and infectious diseases; the inspection of all

kinds of food, particularly in populous centers, and a stern regulation of the dairies. His scientific discourse was supplemented with striking incidences of the difficulty of obtaining appropriations from legislative bodies for carrying on this work, when matters of trivial importance received liberal donations.

Dr. George H. Kress, secretary of the Public Health Commission, gave a most interesting history of the discovery of the means by which yellow fever and the bubonic plague are disseminated, illustrating his talk with stereopticon views of the mosquito and the rat flea, and the domestic fly, and he expatiated upon the work in San Francisco of exterminating the rats. His stereopticon views over the city, of the pall of carbon soot and chemical gases, so fatal to cleanliness, comfort and health, thrown out by the chimneys of the manufacturing plants of greedy corporations, and the engines of the Southern Pacific Company in open defiance of the ordinances and the repeated protests of the city officers, were a most striking object lesson. He showed what good work had been done, even with the limited means at his disposal, in the inspection of small hotels and cheap lodging houses, where were found no means of ventilation, and no attempts made for cleanliness in the furniture, bedding or carpets, and which were becoming centers for the dissemination of disease. A great advance for the health of the community would be made by the establishment of public baths and comfort stations, and the consent of property-owners to the rat-proofing of buildings by concrete floors.

The milk question was an important feature of the discourse of Dr. Kress, and he explained how rapidly diphtheria, tuberculosis, scarlet fever, diarrhoea and other diseases are carried to a community by impure milk. The difference between the regulated and inspected sanitary dairy and the foul sheds of the milk pirate, the inevitable source of disease and death, was most vividly exhibited upon the screen.

In showing the work of the City Health Office, Dr. L. M. Powers, Health Officer, emphasized the vital necessity of a proper disposal of the garbage, and the difficulty of inculcating an appreciation among citizens, especially in the poorer districts, of their danger in allowing filth and decaying food to collect about their habitations. He was much encouraged by the change for the better in the water and milk supply of this city by reason of the power given to inspectors by the late statutes.

All the discourses of the evening were of the most absorbing interest, and received marked attention by the audience. Vice-President Knight announced the subject for the January meeting to be "The Romance of Man; Epochs in His Intellectual Evolution," by President Baumgardt.

JANUARY, 1909.

At the meeting of the Academy on January 4, Mr. B. R. Baumgardt gave an address on "The Intellectual Evolution of Man," illustrated with lantern views. He commenced with examples of the rhythmical processes in all departments of nature, and he showed that human progress was governed by the same laws.

Mankind has had stages of intellectual activity, and then for a time came a rest, and even a seeming retrogression. He divided history into six epochs. Disregarding the early Aryan development of Asia, the dawn may be said to have been ushered in from four to seven thousand years before the

Christian Era, in the Valley of the Nile. Here, learning was confined to the priests who handed down their knowledge from generation to generation, some of it being preserved in the hieroglyphics on their monuments.

The second epoch culminated in the Greek civilization of Pericles, Aristotle, Archimedes and other Greek philosophers, and in the perfection of the arts of Sculpture and Architecture. This embraced a period from the fifth to the second century before Christ.

Arabia and the followers of Mahomet, under the general title of Saracens, developed a high civilization in northern Africa and southern Europe during the first seven centuries of our era, constituting the third epoch. They founded the world's first University in Southern Spain, and the first Astronomical Observatory at Cordova.

The fourth epoch was the renaissance, beginning with Dante in the thirteenth century, and covering 200 years of wonderful art development in the Italian peninsula.

The fifth epoch included the work of the greatest mathematical geniuses of the world—Copernicus, Kepler, Newton, Laplace, and their contemporaries.

The sixth epoch embraces the application of science to modern art, and the consequent amelioration of the condition of man.

HOLDRIDGE OZRO COLLINS,
Secretary.

ASTRONOMICAL SECTION.

Owing to the absence in Europe of the Secretary, no record was preserved of the proceedings of the Astronomical Section from January to June, 1908.

The first meeting after the Summer vacation was held on October 19, 1908, jointly with the Geological Section in the lecture room of the University Club. The subject of the evening, "Luni-Solar Influences in Producing Volcanic Eruptions," was presented by Mr. William A. Spalding in an elaborate paper, and was generally discussed by a large audience.

The section assembled for the November meeting at 621 Witmer street, and listened to a thoughtful presentation by Mr. Knight upon "Geotherms, or Sources of Heat Beneath and Within the Earth's Crust." Careful observations made in different countries seem to establish the fact that in shafts sunk to a depth of one mile or more the temperature increases as depth is reached at the ratio of one degree Fahrenheit for every 60 feet of descent. If this ratio of heat-increase persists, the temperature at a depth of 45 miles will be about 6,000 or 7,000 degrees, great enough to fuse all known substances, and if the pressure of the superincumbent shell or crust

amounting to two and a half tons to the square inch were removed, this hot core of material would instantly vaporize and envelop the earth in a hot, perhaps glowing gas. In considering the origin of this extreme heat, it is assumed that it was primarily derived from the heat generated by the condensation of the original earth nebula, but that the slow cooling of the mass may be due to the presence of radio-active substances, whose slow disintegration evolves large stores of heat.

It has been found that the wonderful new element radium is always associated with uranium in minerals containing the latter substance, and it is believed to be a product of the disintegration of that metal. There are several other radio-active elements such as thorium, polonium, actinium, and all of these are found to pervade many of the rock formations, especially granite. This may account to a large extent for the maintenance of present temperatures in the earth's crust.

"Some European Observatories" was the theme for the December meeting. Mr. Baumgardt described the Observatories at Athens, Paris, Stockholm, and Pulkowa with an account of the work accomplished at those places.

Mr. Collins gave an account of the great Observatory at Vienna and his warm reception by the Director, Professor Edmund Weiss: Of his ascent to the summit of Galileo's Tower in Florence, from which was first seen the four satellites of Jupiter, and of his examination of the little world-renowned telescope in the Specola Natural History Museum at Florence, exhibited to him by the Director, Prof. Constantino Pittei: Of the very pleasant attentions shown him in Rome by Signor Elia Millosevich, the Italian Astronomer Royal, in throwing open for his inspection the Observatory, working rooms and offices erected on the dome of St. Ignatius Church, which forms one corner of the large group of structures in which was located the famous Collegio Romano. From this Observatory the Jesuit Priest, Father Secchi, made his discoveries, and here, in his adjoining private apartments on the roof of the church, he died, February 26, 1878, seven years after the Italian government had driven out the Jesuit owners, shame and the fear of ridicule from the whole Astronomical world preventing the authorities from dispossessing this learned scientist of the place he had made so famous.

Pope Leo XIII gave to the German professor, P. Giovanni Hagen, S. J., the charge of establishing a new Observatory in the private grounds of the Vatican Palace, and the work commenced before Leo's death has progressed steadily under the encouragement and material assistance of Pius X. Here upon the towers of the old walls, which, in ancient days, formed a part of the defenses around St. Peter's Church and the Vatican, commanding an unobstructed view of the heavens from the

entire circle of the horizon, have been constructed three domes, in which are to be mounted modern refractors, the largest of which will have an objective of 16 inches diameter.

The pleasure of the visit to this place, to which access is seldom gained by the "profanum vulgus," was greatly enhanced by a most cordial reception and the personal attendance and explanations from Professor Hagen. He was greatly interested and impressed with the accounts given him of the nearly completed 60-inch Reflector and the great 100-inch Hooker Reflector then in process of construction, both of which were to be erected upon Mt. Wilson.

An amusing incident at the close of this visit was the insistence of the Professor that his visitor should subscribe his name in a beautiful, gold-clasped, leather-bound volume containing the autographs of Pope Leo XIII, and of a large number of the most famous scientists of modern times, who have visited this place; and there is his name as Secretary of the Astronomical Section of the Southern California Academy of Sciences.

HOLDRIDGE OZRO COLLINS,
Secretary.

BIOLOGICAL SECTION.

The Biological Section has held regular monthly meetings during the last year, except in June, July, August and September.

At these meetings questions of technical biological interest were discussed by a succession of able lecturers; those who spoke being Dr. E. L. Leonard of the U. S. C. Medical College, Prof. Esterly of Occidental College, Dr. C. A. Whiting of the Pacific College of Osteopathy, Prof. Miller of the State Normal School and Dr. Hanson of South Pasadena.

During the summer the program committee of the Biological Section provided for an unusually fine course of lectures on bacteriology, and the subjects discussed up to the January, 1909, meeting were as follow, viz.: "The Place of Bacteria in Nature and Their Classification," October 12th, J. Park Dougall, M. D. "How Bacteria Grow, Cultures and Culture Media," November 9th, Ethel L. Leonard, B. S., M. D. "The Relation of Bacteria to Disease," December 14th, J. Park Dougall, M. D. "Theories of Immunity," January 11th, Ethel L. Leonard, B. S., M. D.

The program for the remainder of the year will embrace the following subjects: "Bacterial Sera and Vaccines," February 8th, Carl C. Warden, M. D. "The Opsonic Index and Its Relation to Disease," March 8th, Geo. Martyn, M. D. "Suppurative Processes," April 12th, C. W. Anderson, M. D. "Tuberculosis," May 10th, A. O. Conrad, M. D.

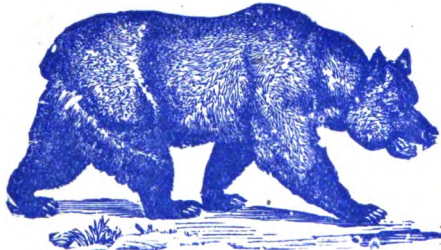
C. H. PHINNEY,
Secretary.

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JULY, 1909



EL CAPITAN, YOSEMITE VALLEY.

BULLETIN
OF THE
Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C. M., M. D. Frank D. Bullard, M. D.

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ROOM 625 SAN FERNANDO BUILDING

Southern California Academy of Sciences

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Editorial

The revival of interest in the growth of *Eucalyptus* has been very general throughout Southern California, and a great demand now exists for all reliable publications relating to this genus of the vegetable kingdom.

Probably the general public attention was first called to the value of this plant by the First Biennial Report of the State Board of Forestry, of which Mr. Abbot Kinney was Chairman. In September, 1896, this Academy published a very interesting volume on *Eucalyptus*, by Mr. Kinney, which was profusely illustrated with excellent half-tone views of many species. Numerous requests for this work have been sent to this Academy, but we are unable to supply copies, as the entire edition has been distributed. In 1902, the United States Department of Agriculture published a very extensive illustrated volume on "*Eucalyptus Cultivated in the United States*," by Alfred James McClatchie, M. A., which is now in great demand, but this also has become one of the scarce books.

In 1903, Dr. J. H. Maiden, Government Botanist of New South Wales and Director of the Botanic Gardens, Sidney, commenced the publication of "*A Critical Revision of the Genus Eucalyptus*." That work was issued in twelve parts, and was completed in 1908. It is very elaborate, voluminous in its text, describing all the known species, and illustrated with large and exquisite plates. This Academy has been the grateful recipient of a copy presented by Dr. Maiden.

During the last winter, there have been upon exhibition in Los Angeles, collections of various species of *Eucalyptus* grown in California, which have opened the eyes of manufacturers to the value of the harder wood varieties for furniture, agricultural implements, felloes and all parts of the wagon, and for polished hardwood interior decoration.

To most people, the title, "*Blue Gum*," appears to be the name for all *Eucalyptus* trees, but this is only one of more than one hundred and fifty species of the genera. It has two distinctive blossoms, one a pale orange and the other, white

with delicate cream yellow anthers. The exquisite flower of the *Eucalyptus ficifolia* and *miniata* is a brilliant crimson blossom, and nearly all the *Eucalyptus* blossoms with their numerous stamens, somewhat resemble the night-blooming cereus, on a minute scale, and they are worthy of a prominent place in all floral displays.

The *Eucalyptus* in California has a very rapid growth, and in very few years arrives to a condition of commercial value—I will not say maturity—for, like the *Sequoia gigantea*, it appears never to cease growing. In all its species it is very prolific, and Mr. Kinney, in "*Eucalyptus*," says that "in an ounce of well-sifted blue-gum seeds there will be 10,000 fertile grains." In 1891 I brought from Riverside a plant of the *Eucalyptus citriodora*—commonly called the "lemon-ver-bena," about the diameter of my thumb and the length of a walking cane, which I planted in rear of my residence in Los Angeles, and today that tree is over one hundred feet in height, seven feet and nine inches in circumference, one foot from the ground, and it is the most striking landmark in St. James Park.

In this Bulletin we present a paper by Mr. Kinney, treating the economic side of *Eucalyptus* culture, and a reprint of a valuable article on "Antiseptic Vegetation for Cuba," by A. Campbell Johnston, originally published by this Academy in September, 1899.

The Story of Ab, that captivating romance by Stanley Waterloo, of events during the paleolithic age, when England was a part of the Continent and when the battle for the Survival of the fittest was being waged the most fiercely, has entertained the evening fireside of old and young and the brain and heart of many profoundly learned in Biology, Geology and Ethnology. It is worthy of a place as well in the library of the most learned as being a most valuable contribution to juvenile literature.

A young lady of Los Angeles, who can lawfully add to her name the College degree of Bachelor of Literature, and who is admired in her social sphere as much for her brilliant intellectual attainments as her charming personality, upon receiving a copy of Ab, returned the following clever acknowledgment:

To thank you for Ab, is my pleasure specific,
That anthropological tale scientific
About hirsute men of such vigor magnific:
They battled with mammoths and serpents terrific,
At a time when it seemed even beasts insectivore
Were not, as they are in our day, insignificant.
This strenuous, hardy folk paleolithic,
Who jumped, not evolved, to the age neolithic,
And made themselves homes in great caves stalactitic,
Or migrated to valleys thro' plains sulphurific,
Have left us as records no altars sanctific,
Such as Druids erected—great piles monolithic,
Only middens and weapons and utensils pacific.
Now pray do not nod o'er this verse soporific.

The organization of a Section of Zoology marks a new era in the life of the Academy. Professor James L. Gilbert, Chairman of the Section, well known in this community for his scientific attainments, is at the head of the Biological Department of the Los Angeles High School, and during the short period of the life of this Section he has accomplished wonders. It has been known for some time that in a depression on the Rancho La Brea, are buried the remains of early fauna of California. A communication from the Academy to Mrs. Erskine M. Ross, owner of the rancho, requesting permission to excavate at this place, brought a most gracious consent, and, owing to the liberality of Mr. John D. Hooker, Prof. Gilbert was able to proceed at once with the work. An opportunity so rare comes but once, and we are fortunate that we have been able to delve in so rich a bed of extinct fauna at the very door of the Academy.

On Monday, July 26, 1909, Prof. Gilbert placed upon exhibition in the City Hall the results of his work since the commencement of the public school summer vacation. A Buffalo skull, with a sweep of horns of 31 inches from tip to tip, the largest ever found; the bones of the Camel, Horse, Antelope, Sloth and Elephant in their most gigantic forms; a skull of the sabre-toothed tiger, complete in all its parts; the head and part of the bones of a huge lion—not the mountain lion of California, but of the African type; smaller cats, rodents and a large variety of birds, great and small, were shown in an unusually excellent state of perfection. None of these are petrified, and their preservation from a time before man made his appearance is explained by their burial in a grave of brea.

This exhibit was inspected by the Mayor and the gentlemen of the City Council, who were so impressed with the value of these discoveries and the fear that the numerous foreign Scientific Bodies, which have applied for permission to excavate in this wonderful deposit, will carry away fossils which should forever remain in a home Museum, that, on the same day, an appropriation of five hundred dollars was made to the Academy for the continuance of this work.

Holdridge Ogro Collins.

Jupiter's Equinoxes and Sun Spots

By William A. Spalding.

About the year 1825, Heinrich Samuel Schwabe, an amateur astronomer of Dessau, Germany, began to observe and record sun-spots. He pursued his investigation for twenty-five years, and, in 1851, published the results of his labors. From the data thus presented a periodicity in sun-spot phenomena was first deduced. The subsequent investigations of Prof. R. Wolf of Zurich, and others, confirmed the deductions of Schwabe, fixing the period from maximum to maximum at approximately 11 1-9 years.

This close approach to Jupiter's period of revolution—11.86 years—at once directed suspicion to that planet as the inciting cause of sun-spot phenomena, and, *pari passu*, other members of the solar system were involved in the inquiry.

De La Rue, Stewart, and other investigators, attacked the problem with great vigor, and promulgated theories assigning sun-spot phenomena to the perturbative influence of various planets, or to the influence of several planets when in conjunction; but the theories thus proposed have not been accepted by the scientific world, because they are not considered as conclusively proven.

In 1886, J. H. Kedzie published a book entitled, "Speculations on Solar Heat, Gravitation and Sun-Spots." He presented a theory that the period of maximum sun-spots is in some way correlated with Jupiter's passage of the perihelion point in his orbit; i. e., the closest approximation of that planet to the sun. His tables, however, showed a wide range of variation, and he was compelled to admit that the period of maximum sun-spots seemed to lag considerably behind Jupiter's perihelion passage.

Following the investigations of De La Rue and Stewart in their efforts to attribute the cause of sun-spots to the joint influence of various planets, Prof. John H. Tice, Superintendent of Public Schools of St. Louis, Mo., in 1862, took up this line of research, with the hope of discovering the cause of the eleven years sun-spot period and also of extending the inquiry to see whether there might be a similar periodicity in telluric and atmospheric disturbances. In other words, his hypothesis was that the same great cause lies behind sun-spots, magnetic

and electrical disturbances, earthquakes, volcanic eruptions, hurricanes, tornadoes and atmospheric disturbances of all kinds. This cause he assigned to the **equinoctial** perturbation proceeding from the various planets of the solar system. After an investigation extending through twelve years, Prof. Tice, in 1875, published a treatise on Meteorology, setting forth his theory and the results of his observation and research. This treatise, while challenging respectful consideration, is not presented in such a logical and well-digested manner as to be considered convincing testimony in support of his theory.

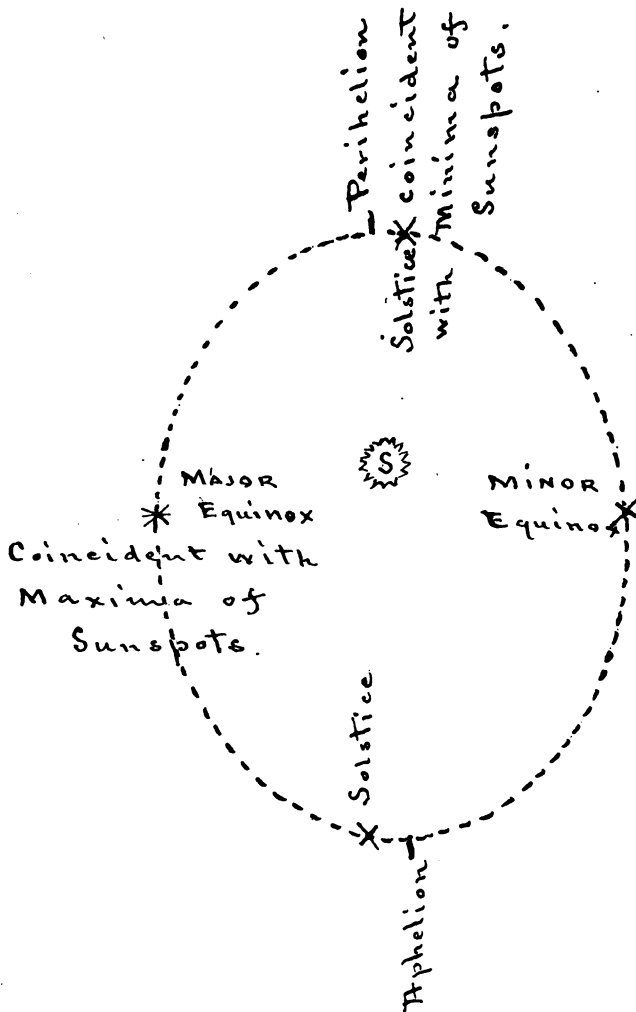
Thus the investigation has drifted until the present time without attaining results that are regarded as conclusive. **The cause of the eleven years sun-spot cycle remains as much a mystery as ever.**

In 1890 I obtained Prof. Tice's work on Meteorology, and was so much impressed with the reasonableness of his theory that I engaged in a serious study of the subject, which has been prosecuted with more or less constancy during the subsequent years. It seemed to me that the great desideratum was to first make a demonstration of physical facts. Is there an actual concurrence between Jupiter's equinoctial passage and sun-spots? It ought to be possible to demonstrate this proposition so thoroughly that there would no longer be a reasonable doubt on the subject. The physical facts being first established, a theory would be forthcoming; perhaps several theories.

In this paper I attempt to show that there is a very close and well-sustained approximation in dates between Jupiter's major equinox and maxima of sun-spots; also, as a corollary to the foregoing, that there is a close and well-sustained approximation between Jupiter's solstice near the perihelion passage, and minima of sun-spots. This constitutes a double demonstration in support of Prof. Tice's theory.

The equinoxes of Jupiter, like those of the earth, occur approximately midway between the perihelion and aphelion points in his orbit. The equinox which succeeds the perihelion passage is termed Jupiter's major equinox. This equinox is nearly coincident with sun-spot maxima.

The solstice which approximates Jupiter's perihelion passage (corresponding to the earth's winter solstice) is taken as the point nearly coincident with sun-spot minima. The following diagram will serve to illustrate our thesis:



Jupiter's Orbit - Showing
Aphelion, Perihelion, Sol-
stitial and Equinoctial
Points

The most reliable data concerning sun-spots begins with Schwabe's observations about 1825 or 1826, and extends down to the present time. The older data generally embodied in tables were collected by Wolf, about 1850, long subsequent to the events. According to Prof. Young, Wolf rummaged in attics and unearthed scraps of astronomical records, taken mainly with no idea of periodicity, and with these he pieced out, as best he could, the earlier part of the table, from 1610 to 1826.

In the following table we have taken Schwabe's data of sun-spot maxima from 1837 down, supplementing his table with authenticated later records, in order to institute a comparison between these dates and the dates of Jupiter's major equinoxes:

Major Equinoxes of Jupiter.	Sun-Spot Maxima.	Difference.
1836.16	1837.2	+1.04
1848.02	1848.1	+ .08
1859.88	1860.1	+ .22
1871.74	1870.6	—1.14
1883.60	1883.9	+ .30
1895.46	1894	—1.46
1907.32	1906-7 (?)	(?)

In the above table when the sun-spot maximum is subsequent to the equinox the difference is indicated with a plus sign; when the maximum precedes the equinox, the difference is marked with a minus sign. The greatest variations are +1.04 and —1.46 years, and the average of all is only .706—say an average difference of only eight and one-half months. This covers a period, in the definite comparison, of fifty-seven years. Including the 1906 or 1907 date, which, when results are calculated, will probably show a close approximation, the entire period covered is seventy years. This seems long enough to constitute a very fair investigation. No other comparison of an astronomical event with sun-spot maxima has shown such a close coincidence.

The equinoxes of Jupiter being nearly midway between the perihelion and aphelion points, it follows that the solstitial points must nearly coincide with the perihelion and aphelion points in his orbit. According to Prof. Tice, the solstices of

Jupiter should indicate the periods of least solar disturbance; the solstice which is nearly coincident with the perihelion passage being taken as corresponding to the present recognized period of minimum sun-spots. We have accordingly prepared the following table to institute a comparison between Jupiter's solstice corresponding to the earth's winter solstice (near perihelion) and the sun-spot minima. Wolf's data are taken for sun-spot minima, and Tice's for Jupiter's perihelion dates which the solstice approximates:

Jupiter's Solstice near Perihelion.	Sun-Spot Minima.	Difference.
1832.11	1833.9	+1.79
1843.97	1843.5	+ .47
1855.83	1856	+ .17
1867.69	1867.2	— .49
1879.55	1879	— .55
1891.41	1889.6	—1.81
1903.27	1901.5	—1.77
Greatest + variation		1.79
Greatest — variation		1.81
Average +		.81
Average —		1.15
Average of all		1.+

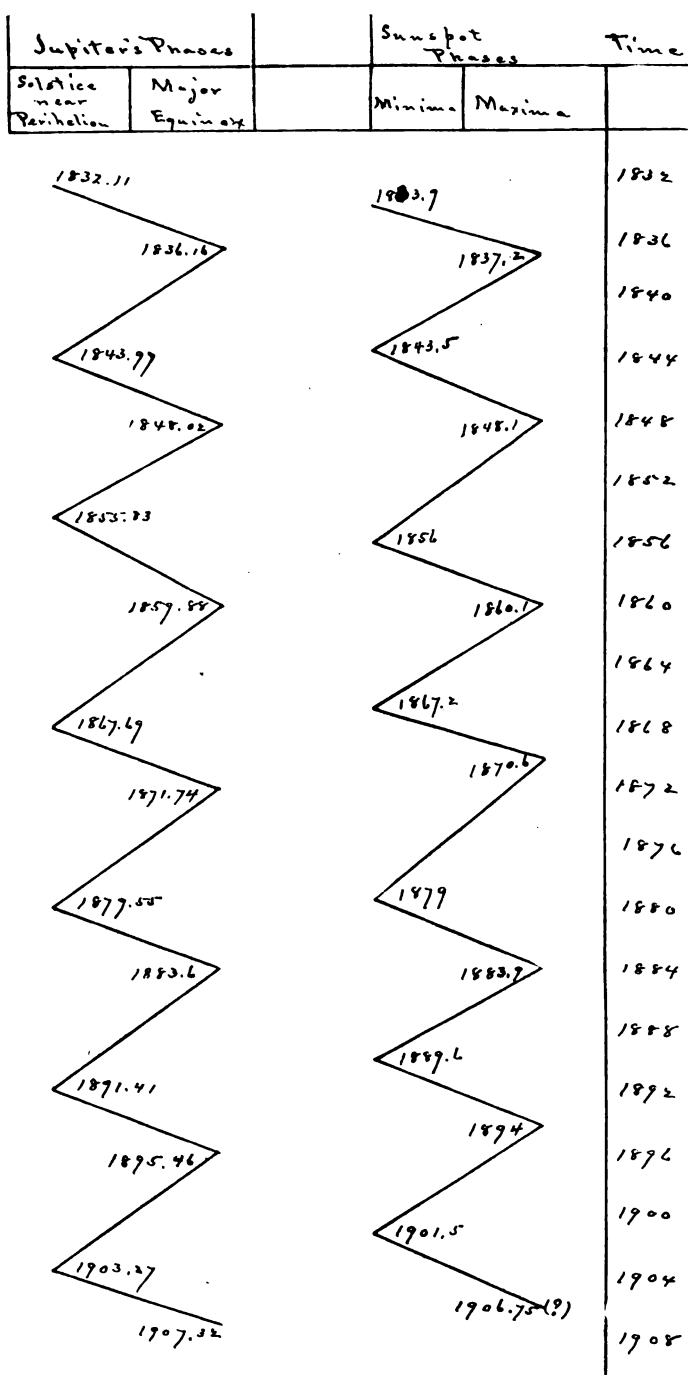
Here, as before, when the sun-spot minimum precedes the solstitial date, the difference is prefixed by a minus sign; when the sun-spot minimum follows the solstitial date, the difference is prefixed by a plus sign.

In the above table the approximations are not so close as in the preceding, but still close enough to be quite remarkable. This, at any rate, constitutes a double comparison, which tends to sustain our position from both points of observation.

Prof. Tice allows three years for the duration of an equinoctial disturbance of Jupiter—three-fifths of that time before and two-fifths after the equinoctial passage—so that the variations found in the first table come well within the limit allowed.

To make this showing of approximations more evident, we present the following graphic diagram:

Diagram Showing Correlation of Sunspot Phases and Phases of Jupiter



The Variation of the Compass in Southern California and the Difference of Time Between the Tides at San Pedro and San Diego

By B. R. Baumgardt.

The Astronomical Section has frequently been asked to supply a table of the local variations of the compass. In reply the following information is indicated:

Los Angeles	14.6 East
Santa Barbara	14.7 East
Barstow	14.7 East
San Diego	13.6 East
Yuma	13.5 East

As these variations of the compass are all toward the East, they must be applied to the right of the magnetic bearing.

The variations of the compass are not constant in any part of the world. Locally, the secular change is exceedingly small and may be neglected.

Tides

The interval between the moon's transit and succeeding high water for our two Southern California harbors is as follows:

San Diego (mean interval)	9h. 38m.
San Pedro (mean interval)	9h. 39m.

The difference in the lagging of the tides between the two harbors is, as will be seen, exactly one minute.

The difference between the maximum and minimum interval is, for the two respective harbors,

San Diego	1h. 35m.
San Pedro	1h. 48m.

a difference of 13 minutes.

Chronology of the Bulletin

The publication of the Bulletin of the Southern California Academy of Sciences was commenced in 1902, and has been continued down to the present time, embracing 8 volumes, viz.:

VOLUME I, 1902.

Nos. 1 to 10 inclusive, for the months of January to August, November and December, with Supplement Index.

VOLUME II, 1903.

Nos. 1 to 9 inclusive, for the months of January to June, October, November and December, with Index.

VOLUME III, 1904.

Nos. 1 to 9 inclusive, for the months of January to June, October, November and December, with Index.

VOLUME IV, 1905.

Nos. 1 to 9 inclusive, for the months of January to June, October, November and December, with Index.

VOLUME V, 1906.

Nos. 1 to 3 inclusive, for the months of March, June and December, with Index.

VOLUME VI, 1907.

Nos. 1 to 2 inclusive, for the months of March and July.

VOLUME VII, 1908.

Consists of only No. 1, January.

VOLUME VIII, 1909.

Nos. 1 and 2, for the months of January and July, with Index.

Index to Volumes VI and VII was sent out with the January number of Volume VIII.

The Academy will make a liberal exchange, or pay a reasonable price for monthly Numbers of Volumes III, IV, V and VI of the Bulletin, which are needed to complete files, for which there are many requests.

Eucalyptus for Hardwood

By Abbot Kinney.

Popular interest in the planting of Eucalyptus has increased. This increased interest is due to the realization of the proximate exhaustion of the Native American hardwoods. Our hardwoods are not only becoming scarce and expensive, but no new natural supply is in sight. Nor will the care of the forester fully remedy the situation. This is because of the slow growth of the Native hardwoods. The Eucalypti alone give any promise of filling any portion of the growing demand for hardwoods within a reasonable time.

The genus Eucalyptus is native to Australasia. Australia and Tasmania are the source of supply of all the species known to be of commercial value. Not one species of Eucalyptus is native to New Zealand, and only a few are found in New Guinea, Timor and neighboring tropical islands near Australia.

None of the species will tolerate much frost. Eighteen to twenty degrees Fahrenheit is the limit of safety for the hardiest commercial kinds.

The commercial planting of Eucalyptus is consequently restricted to California or so nearly so, on account of climate, that we can say that within the United States, California has a natural monopoly in the commercial production of the trees of this genus.

The most valuable species of Eucalyptus have several exceedingly attractive qualities for private commercial planting.

The first of these is rapidity of growth. It is a moderate statement that the *E. globulus* or common blue gum will produce a good crop of wood in from ten to fifteen years.

Second—The Eucalyptus in the Californian experience will produce well in solid plantation of one kind or species. The importance of this will be realized when the fact is recalled that the general forestry practice is to plant other hardwoods in mixed plantations for good results. The economy of handling solid groves of one kind of tree is an important advantage that the Eucalypti so far have been found to have in California.

Third—Rapid growth from the stump after cutting. There appears to be no limit to the number of times that most Eucalyptus trees will make a new and valuable growth.

This new or pollard growth should be thinned out about

the second year, and again about the fourth or fifth, and the main commercial crop would be due again about the seventh year.

Fourth—The Eucalypti in California are free for all practical purposes from parasites or fungi. The appended article from the U. S. Department of Agriculture indicates the importance of this characteristic:

How Hardwoods Decay.

“Hardwood trees in the forests are attacked by many enemies. The mistletoe, the ‘witches’ broom,’ and the southern mosses are all parasites that weaken and even destroy the trees. But by far the greater number of diseases of trees are caused by fungus growth. Some fungi destroy the leaves, some rot the roots, and some girdle the bark. Chestnut orchards have been destroyed in many places in the East by a kind of fungus which girdles the bark and kills the tree.

“Then there are many kinds of fungus which rot the wood of standing trees, with no outward sign until after the value of the tree has been destroyed. The white heart-rot is the most common of these. It attacks the oak, walnut, hickory, beech, maples, and many other trees. The heartwood of the tree is changed by the action of the fungus into a light-colored, flaky sort of substance which has no strength and can no longer be called wood. Such a tree may live for many years, even though badly diseased, but it has no value for timber.

“The outward sign, when it does appear, is a shelf-like growth upon the trunk. It is hoof-shaped, about as thick as wide, and may be anywhere from one to two inches wide to twelve inches or more. The upper surface runs from brown to black, the lower surface from gray to red-brown. Wherever such a tree is found it should be removed at once, for the longer it stands the less it is worth for timber, and it will surely spread the disease to other trees. Any sort of wound in a sound tree, such as a broken limb, gives an opening for the fungus to enter and establish itself, unnoticed until the heartwood is destroyed. Wherever such a wound can be promptly coated with hot coal-tar creosote, or some other good antiseptic substance, it may be saved from infection.”

Fifth—The sanitary influence of Eucalyptus plantations is good. The general effect of the blue gum in particular is to reduce or remove conditions leading to malarial disease. They have been planted for this particular purpose in Italy near Rome, in Corsica, and in Algiers.

The leaves of the blue gum, *E. globulus*, are the recognized reliable source of Eucalyptus oil and its product, Euca-

lyptol. It is a powerful antiseptic and is used for this purpose, and is also a valuable medicine.

The market for Eucalyptus oil appears to be reliable. As a consequence, the blue gum grove has a value not shared by other species. When the trees are cut, the leaves can be distilled cheaply, and in skillful hands the oil will pay all the cost of cutting a grove into firewood and of the distilling. If the grove is cut for a better market, the value of the oil is equally profitable.

In planting Eucalyptus for profit, a great deal of study and care should be given to the character and quality of the soil, to the climate and to the need of water and the cost of the same where irrigation is required for a full and quick return.

E. rostrata or the red gum, and *E. tereticornis*, stand the most heat and cold, and are therefore the best trees with others of their type for our arid districts.

In the coast valleys practically all species of Eucalyptus do well. The only exception known to us, so far, is the celebrated "Jarrah" of Southwestern Australia. This is the *E. Marginata*. We have no record of a successful planting of this species.

There is always something of a fever amongst us Americans when a new and promising thing is brought to public attention. The Eucalyptus planters are liable to this fever, even if they are free from other fevers, through the Eucalyptus oils. Care and investigation should be the rule with investors. There seems, however, no way to overdo hardwood plantations in this country.

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CONTENTS:

Antiseptic Vegetation for Cuba

BY

A. CAMPBELL JOHNSON

Chairman of the Botanical Section

LOS ANGELES, CAL.

SEPTEMBER, 1899

Antiseptic Vegetation for Cuba

The word antiseptic is applied to vegetation planted for the purposes of killing germs, either in the ground or air, and combating the ravages of fever and disease. The late Baron Ferdinand von Müller first made use of this word which so aptly describes the various genera of Myrtaceous vegetation now recognized as one of nature's great gifts to mankind. For over forty years he devoted his life to the classification of the flora of Australia, at that time almost unknown to the world, and he himself attributed the salubrity of the coast climate of Western Australia largely to the prevalence of Myrtaceous trees and shrubs. As yet it has hardly been definitely settled how this is accomplished; but recognizing the presence in these plants of volatile oil, the purification of the soil and air is probably accomplished partly by drying up unhealthy swamps, and possibly the roots directly feeding on the destructive germs contained in the soil, and partly by the diffusion of an antiseptic ether, deadly to these germs; partly also by the direct absorption and deodorizing action of the leaves. It is not, however, my intention here to enter into the chemistry of the oils of the *Melaleucas* or *Eucalyptus*, as little is at present known as to the former; and as regards the latter, much yet remains to be investigated, and also it is not yet definitely settled how this vegetation favorably affects climates.

Before proceeding directly to discuss the various plants recommended for trial, we would like to suggest the conditions we would have to meet in Cuba. The United States Government has already been making some inquiries, and I think it is especially timely for the Academy of Science of Southern California to collect and classify the information we have, especially as our President, Mr. Abbot Kinney, has written what is now the standard work on the successful introduction of the *Eucalyptus* (one great genus of antiseptic vegetation), and, with Mr. Elwood Cooper and other pioneers, has so widely distributed the various species that they now form one of the chief features of our Southern

California landscape. I am inclined, however, to believe the conditions which prevail in Cuba are somewhat unusual. At Havana harbor one of the great difficulties the late Colonel Waring (who so nobly gave up his life in investigating these conditions) had to contend with was the prevalence of marsh lands, over which the sewage of the city had to pass, and the exposure of these mud flats during low tide, and one of his recommendations provided for the draining and reclamation of these mud flats. And possibly, for the amelioration and improvement of health conditions in other parts of Cuba, the United States would have largely to deal with somewhat similar conditions. Assuming this to be somewhat the case, I have placed the genus *Melaleuca*, one branch of the great family of *Myrtaceae*, first on the list as worthy of trial, because some of the most useful species extend into tropical climates, and because, in the *Manuel de l'Acclimateur*, by Charles Naudin and Baron Ferd. von Müeller, the standard work on plants adapted to the different climates of Europe and tropical countries, it is stated, in describing one species, that "This *Melaleuca* grows vigorously in earth impregnated with salt water where no *Eucalyptus* could live, and it does much to ameliorate the unhealthfulness of the climate. *This remarkable attribute* ought to recommend its culture in colonies established near marshes or lagoons in countries surrounding the Mediterranean Sea, principally in Algeria." He goes on to mention several other species which are equally valuable, and which I will refer to in detail.

The first to recommend will be the *Melaleuca leucadendron*. From the leaves of this and allied species or varieties is distilled the oil of cajeputi, an essence generally green, with a somewhat agreeable and very penetrating odor, employed from time immemorial in Chinese India, externally and internally, for rheumatism, nervous affections, malignant fevers and cholera. A very nearly allied species, *Melaleuca virideflora* or *niaouli*, of New Caledonia, extends as far north as the Indian Archipelago. Besides oil and bark it furnishes the natives with building timber, and in utility is to this country what the *Eucalyptus* is to Australia. These various forms are sometimes united as only varieties of *Melaleuca leucadendron*, sometimes given specific rank.

Melaleuca minor, in Java and Molucca, also produces oil. *Melaleuca cajuputi*, long considered as only a form of *Melaleuca leucadendron*, is found in the Indian Islands as far west and north as the southeast coast of Borneo. It is in the islands of Borneo and Ceram where the two largest forms are found, and the leaves and bark are used by the natives. The tree stands out in the forest, having a white bark like birch bark. The

number of the closely allied species or forms, spreading from Western Australia from latitude 34° almost to the tropics, would justify a belief in its extreme adaptability to various conditions. I note the following description by J. H. Maiden: "It is called in Australia White Tea-tree, is a large, shapely, umbrageous tree, which has broad leaves and white or creamy flowers, and which is found in nearly pure sea sand, or by the side of brackish creeks." I have recently received a specimen of this tree growing in San Diego.

We have perhaps another form of it in our parks in Los Angeles. Among others recommended are *Melaleuca ericifolia*, making quite a tree; *Melaleuca linariifolia*, somewhat common in our parks in Los Angeles; *Melaleuca genistafolia*, all suitable for trial.

The genus *Melaleuca* comprises over one hundred species, many of them worthy of trial. Before leaving this attractive genus it may not be out of place to touch on the great beauty of many of them. Dr. Franceschi, an importer of new, useful and ornamental plants, tells me that at Naples this was almost the only plant used for decorating the summer villas erected on a promontory of land reaching out into the sea. Nothing else would withstand the direct sea breezes. Two specimen trees of this genus, *Melaleuca Huegeli*, nearly sixty feet high and the stem four feet in circumference, and *Melaleuca cuticularis*, twenty feet high and nearly five feet in circumference, are well known trees in the Cape Town Botanical Garden. It may also be found that the *Callistemons*, a very nearly allied genus, may provide some trees worthy of trial. A tree of *Callistemon speciosus*, nearly twenty feet high, is one of the sights of Santa Barbara.

Before discussing the *Eucalyptus*, I would like briefly to refer to a few more genera which may be included under the head of antiseptic vegetation. *Leptospermum loevigatum*, also known as *Fabricia laevigata*, is well known in San Francisco from being largely used in reclaiming the sandy soil of the Golden Gate Park. It makes quite a tree, and with *Leptospermum lanigerum* is recommended by Charles Naudin, who says it is supposed to have the effect of driving away malaria from swampy places, and fulfills the same health giving role as *Melaleuca ericifolia* and many of the *Eucalypti*. *L. flavescens* extends as far north as the Philippines, and several other species extend to the Northern portion of Western Australia and are suitable for experiment. The leaves of *L. scoparium* were used infused as tea by Capt. Cook and his crew on his voyage of discovery.

Another genus belonging to the Myrtaceae, probably the most widely spread over the various islands of the Indian Archi-

pelago and Oceanica, are the *Metrosideros* and *Xanthostemon*. Of the latter, twenty-five species are endemic to Australia, ten in New Caledonia, and one (*X. verdugonianus*) in Mindanac. Indeed, it is probable that several useful Myrtaceous plants might be introduced from the Philippines. The *Metrosideros* polymorpha, named on account of its varying types, forms the most generally prevailing trees on the Hawaiian Islands between 1500 and 5000 feet. *Metrosideros vera* is one of the iron woods of Molucca; *Synearpia laurifolia*, now classed with the *Metrosideros*, is one of the most valuable shade trees of Australia. But, though all the dry capsular seeded forms of the Myrtaceae may prove valuable, I think enough has been suggested, and I will proceed to the discussion of the *Eucalyptus*, which undoubtedly, in the higher mountainous regions of Cuba, will be most successful; and some few species may prove valuable in the tropical lagoons near the coast.

With the consent of Mr. Abbot Kinney, the author of a work on the *Eucalyptus*, I make use of much of the data he has collected that directly applies to the introduction of this family of trees into tropical countries. Prof. Charles Naudin says:

"The introduction of the *Eucalyptus* into tropical countries has up to now been only moderately successful; more especially have they failed where the heat is almost uniform and the humidity of the atmosphere very great. Speaking generally, the *Eucalyptus* requires a season of rest, either by reason of a fall in the temperature or a prolonged dry season. There are, however, a few species which seem to have succeeded in the tropics, which we note in the following descriptions:

E. abergiana possibly can be acclimated in tropical countries.

E. capitellata succeeds in wet sand, and may be used where the climate is not too unfavorable.

E. resinifera is one of the *Eucalyptus* which best succeeds in tropical climates. It has been successful in India at Lucknow.

E. terminalis comes from tropical Queensland and may succeed in other tropical countries." This completes Charles Naudin's list.

Mr. Abbot Kinney states:

E. calophylla succeeds in the moist tropics of Zanzibar, but its leaves are very deficient in oil.

This seems rather a small list, but it by no means follows that out of one hundred and fifty species known that many have been tried. Even in our experiments with sixty or seventy species in California, we have great surprises. No doubt from the extraordinary divergence from types we find in seedlings, in an extended trial some would be better adapted to these apparently adverse conditions, and owing to the early production of

seed a new generation could be introduced in a few years that would succeed. I would recommend especially for trial *E. Corymbrosa*, found in forests associated with *E. abergiana*, and also I would especially recommend *E. alba*, a species extending to the islands north of Australia, particularly interesting, as perhaps, forming a link between the *Melaleucas* and *Eucalypts*. It is stated that Cajeput oil is sometimes distilled from its leaves.

Owing to the difficulty of sprouting all Myrtaceous seeds of trees, the least humidity in the air, or rain damping off the young seedlings, it would be more desirable to ship plants from California when well established, in pots. We have growing here nearly seventy species of *Eucalypts*; also some twenty-five to thirty other Myrtaceous plants suitable for experiment. In no other region in America have so many plants of this great Australian family of Myrtacea been introduced. This is owing to their finding here so congenial a home.

In conclusion I would ask the Academy of Sciences of Southern California to endorse the establishment of a Botanical Experiment Station near Los Angeles, or in our parks, for the following reasons:

Because vegetation recognized as antiseptic is largely Western Australian, and trees from this region have been so uniformly successful here. In no other portion of America do so favorable climatic conditions prevail.

Because *the investigation* of these various growths and their comparative antiseptic value would confer on mankind and the American people a greater benefit than any other experimental station by promoting health and prosperity in regions now almost uninhabitable for the Anglo-Saxon race.

A. CAMPBELL JOHNSTON,

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South Limits of Coast Range Trees.—I.

By Willis L. Jepson.

The greatest development of forest and woodland in California occurs in the Mendocino and Humboldt areas. This fact is not only true as to the number of individuals and the size of individuals, but it is also true as to the number of species composing the forest in the north coast district. Nearly all of the species composing this great coast forest are derived from the north and have their south limits in Humboldt or Mendocino counties, sometimes in Sonoma County. A few others, as we definitely know, go as far south as Marin or cross the Golden Gate to the Santa Cruz and Santa Lucia mountains.

Going back to our classical authority on the Botany of California, viz., the volumes of the State Geological Survey, we find a reference of still other species to Marin County, Santa Cruz mountains and the Santa Lucia mountains as the south limits, but without indication of definite stations. These various statements of south limits have since the days of the Botany of California been so faithfully copied from one monograph and text into another that the mere sense of literary authority seems now to place them beyond challenge, and yet many of these stations may well be brought under profitable scrutiny and question at the present time.

Tsuga heterophylla Sarg. The Coast Hemlock is attributed to Marin County in the Botany of California, vol. 2, p. 121, the reference to Geo. R. Vasey resting (inferentially) upon specimens collected by him. This species could not well grow in Marin County, except on the western slope of the Bolinas Ridge, between Muir woods and Tocaloma, a botanically well explored region, where, although searched for, it has not been located. Having never seen it myself, I have made inquiry of many devotees of the Marin woods, but always with negative results. The statement of Miss M. E. Parsons, who resides at the base of Mt. Tamalpais, may be regarded as typical: "I have never seen the Coast Hemlock in Marin County. I made inquiry of my friend, Robert Menzies of San Rafael, who immediately said that he and his friends had had frequent discussions upon that point, and that they had come to the conclusion that the supposed occurrence of the tree in Marin was a myth. Mr. Menzies is an ardent lover of trees, a keen observer and a great trampler, so I should give his experience serious consideration."

Taxus brevifolia Nutt. The Western Yew is attributed to

the Bay of Monterey by Sargent (Silva N. Am., vol. 10, p. 65), on the shores of which it is unlikely to occur. Anderson gives a station (Laguna Creek) in his Santa Cruz County list; otherwise, definite localities are unknown, south of the Bay of San Francisco. The sharp, deep cañons of the western slope of the Santa Lucias offer a suitable environment for Western Yew, and further search may well be made for it in this region.

Torreya Californica Torr. The south limit of the California Nutmeg, as at present known, is in the Santa Cruz mountains. The following note regarding occurrence in this range has been furnished by Robt. L. Pendleton: "Hume Cañon, several small trees about 15 to 20 feet high, 1000 feet elevation; Norton Cañon, small trees, numerous but scattered, between 1000 and 1500 feet; Saratoga Cañon, small trees, scattered, between 1000 and 2000 feet. One small tree near the summit of Castle Rock Ridge, Santa Cruz mountains, 2800 feet. This is the only tree near the summit for several miles. All of the above are on a north slope in quite thick forests of the main Castle Rock Ridge, or the single mountain northeast, which lies between Saratoga and Los Gatos, and are in Santa Clara County. There is one station in Santa Cruz County, on a ridge about two miles southwest of the Saratoga summit. Here there is a good deal of fog and so the trees grow in more open country, although still on the northerly slope. I have also learned of a specimen which is growing along the coast near the mouth of the Waddell Creek, Santa Cruz County, which has a trunk about a foot through, and resembles *Pseudotsuga* in habit."

This species has also been observed by the writer in Archibald Creek Cañon, within a few miles of the Santa Cruz coast, the trees more numerous than seen elsewhere, and varying from saplings to trees past maturity, the latter 85 to 105 feet high, and $4\frac{1}{2}$ to 7 1-3 feet in circumference at 4 feet above the ground.

Thuja plicata Nutt. The southernmost definite station for the Canoe Cedar, so far as known, is on the northerly slope of the Bear River Range, south of Ferndale, near the sea, in Humboldt County; I saw it here in 1902. The trees grew near what is called the Wild Cat grade, and were about 75 feet high. The spray-like branchlets drooping in close or compacted bunches gave the appearance, at first glance, that the trees were wilting. I have never observed this species in the Coast Range woods southward; although attributed to Mendocino County in Sargent's Silva, vol. 10, p. 130, no exact station is given. It is, indeed, not at all improbable that it may exist in Mendocino County, but it is certainly rare enough to be

worthy of the distinction of an exact station. In the Botany of California, vol. 2, p. 115, the following statement occurs: "Rather rare in California. It is said to range from San Diego County to Sitka." The San Diego error goes back, doubtless, to John Torrey and C. C. Parry in the Botany of the Mexican Boundary Survey, p. 211, who, in all probability, confused the species in question with *Librocedrus decurrens*.

Quercus garryana Hook. The Oregon Oak forms a considerable part of the mixed forests of Humboldt, Mendocino and Sonoma counties inside the Redwood Belt. It also grows on the northerly slopes of Mt. Tamalpais, in Marin County. I know of no exact station south of San Francisco Bay, nor have I seen it in the Santa Cruz or Santa Lucia ranges. It may well occur on the higher slopes of the Santa Cruz mountains, where it is said by Sargent (*Silva North America*, vol. 8, p. 30,) to exist, but he does not cite a definite locality. There is also a possibility that it may be found in the Santa Lucias in some favorable situation.

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Transactions of the Academy

This record is continued from page 42, Volume VIII, of the Bulletin, January, 1909.

FEBRUARY.

At the meeting of the Academy on February 1, 1909, a very large audience gathered at Blanchard Hall and listened with intense interest to Professor George E. Hale, who described the late work on Mount Wilson and the results, so far obtained, of his observations of the sun.

The construction of the Snow Reflector and the newly completed 60-inch Reflector, with their housings was explained and views of the sun-spots showing their right and left-handed vortices and the hydrogen flocculi were thrown upon the screen. These observations seem to prove, almost conclusively, the existence of a magnetic field in sun-spots, and the polarization of the light, both from these spots and from other portions of the sun's surface will undoubtedly give results which will be the foundation for the examination of the constituent qualities of the stars.

The enormous light-gathering power of the new 60-inch Reflector and the sharpness of its power of definition were shown in the photograph of the great nebula of Orion, the most wonderful celestial photograph ever taken, and exhibited this evening before this Academy, for the first time. This photograph is to be shown to the Astronomical Bodies of Europe by Prof. Hale during the coming summer.

The investigations by means of these powerful telescopes have already begun to show the origin of the stars and planets; their condensation from nebulae and their evolution through periods of time—illimitable to us—to a condition when the star blazes in its full maturity, and its satellites, or planets, are the homes of vegetable and animal life, through old age, extinction and death.

It is the proud distinction of this Academy to place upon record the first public declaration of the results of the examination of our sun, the stars and nebulae, by means of this 60-inch Reflector.

The following communication from Hofrat, Professor, Doctor Edmund Weiss, Director of the Vienna Observatory (Sternwarte), was read and received with pleasure, viz.:

“Vienna, 16 January, 1909.

“XVIII Spottlegasse 19.

“The Southern California Academy of Sciences, Los Angeles.

“I return my sincere thanks to the esteemed Academy of Sciences for the honor which she has conferred on me by the election as Honorary Member—an honor which I highly appreciate.

May I add that it will always afford me a great satisfaction if I can assist the Academy in her scope and endeavors to promote sciences, and that I will send henceforth my papers to her Library.

“I conclude in expressing to the Academy of Sciences my hearty wishes in the motto of our Universities,

“Vivat, Floreat, Crescat,

“PROF. DR. EDMUND WEISS.”

With hearty thanks to Prof. Hale, the Academy adjourned.

A meeting of the Directors was held in Blanchard Hall at 7:45 o'clock P. M., on February 1, 1909, at which E. H. Rose and Dr. Thomas A. Rex were elected members.

Professor George E. Hale and Dr. J. H. Maiden of Sidney, New South Wales, were elected Honorary Members of the Academy, and the Board adjourned.

A meeting of the Directors was held at Room 625, San Fernando Building, on Thursday, February 11, 1909, at 5 o'clock P. M.

In the absence of the President and both Vice-Presidents, Dr. Whiting was elected chairman.

Judge F. W. Gregg, Dr. Andrew S. Lobingier, Daisy D. Hayden, L. M. Whiting and Olive Clarke, were elected members of the Academy.

The subject of charging an admission fee to the general public at the monthly meetings of the Academy, proposed by Mr. Keese, was discussed, but action was deferred so that it could be presented at a meeting when all the Directors shall be present.

The Board adjourned, subject to the call of the Secretary.

MARCH.

The regular meeting of the Academy for March was held in Blanchard Hall before a large audience, members and citizens.

Captain Amos A. Fries of the Engineer Corps of the United States Army, who is in charge of the Government works at San Pedro, addressed the meeting upon the subject of "San Pedro Harbor, Past and Future: Its Commercial Possibilities, Proposed Fortifications and its Consolidation with Los Angeles."

His discourse was illustrated with maps and drawings, and his explanations of the present condition of the Harbor, and the proposed additions and improvements by the Government and by private enterprise, were most lucid and interesting.

At the close of the lecture the Captain was put upon the witness stand and subjected to a searching cross-examination by individuals in the audience, which brought out many facts which have not been generally known. For an Army Officer, the Captain proved himself a pretty good Lawyer, as he explained in a very clear manner the laws, Municipal, State and National, relating to the Harbor, its front or dockage lines, its tide lands and approaches.

A hearty vote of thanks was given him by the audience.

A meeting of the Directors was held on Wednesday, March 17, 1909, at 4 o'clock P. M., in the office of the Secretary, Room 625, San Fernando Building.

Present—Messrs. Baumgardt, Beeman, Collins, Keese and Whiting.

The record of the previous meetings of the Directors was read and approved.

The Secretary reported that he was corresponding with Dr. David Starr Jordan and there was a prospect of securing him as the lecturer for the April meeting, 1909.

The President reported that Dr. G. Martyn had been secured for the May or June meeting.

A communication was received from Mr. Samuel Fox, relating to a proposed excavation in the Rancho La Brea, west of the City of Los Angeles, which is owned by Mrs. Ida Hancock, and the Secretary was instructed to inform Mr. Fox that while the Directors are in full sympathy with this project, there are no funds subject to their control which are available for this purpose.

Board adjourned.

APRIL.

At the April meeting of the Academy, held in Symphony Hall, Dr. Norton J. F. Hazeldine spoke upon the religions of the people of India and he illustrated his discourse by quotations from a literal translation of the Rubaiyat of Omar Khayyam. From his intimate association from childhood with the priesthood and leaders among the

highest intellectual element, he showed that a profoundly religious sentiment, and a belief in a spiritual existence after death, prevails throughout those lands, and that, among teachers, the materialist is unknown; that Fitzgerald's translation of the Rubaiyat gives an entirely incorrect idea of the religious thought of the East.

MAY.

The Annual meeting of the Academy was held in Symphony Hall, May 3, 1909, and the following named gentlemen were elected Directors for the ensuing year, viz.:

Bernhard R. Baumgardt, Frank D. Bullard, Holdridge O. Collins, Anstruther Davidson, John D. Hooker, Samuel J. Keese, William H. Knight, George W. Parsons, William A. Spalding, William L. Watts and Clement A. Whiting.

The subject of the evening was "The Opsonic Index, or the Role of the Blood in the Vaccine Treatment of Consumption," which was presented by Dr. George Martyn.

The lecturer explained Nature's method of producing immunity from infectious diseases and he dealt with the scientific facts discovered by the great teachers from Jenner, Pasteur and Lister, up to Metchnikoff, Koch and Wright, connecting the discovery of vaccination with the modern treatment of Tuberculosis by tuberculin; the cause of Nature's break-down under the ravages of infection and the scientific means of restoring the balance between health and disease.

From the nature of the subject, it was necessarily technical, but it was listened to with marked attention by the audience, among whom were many of the most prominent physicians of the city.

The discourse was illustrated by drawings and X-rays views of lungs in conditions of disease and health.

An animated and interesting discussion ensued upon the close of the lecture, in which were shown the necessity of separate Hospitals and retreats for the treatment of Tuberculosis, and the constant danger to the public by the neglect to furnish suitable means for adequate treatment of this dreadful disease.

Immediately after the adjournment of the Annual Meeting of the Academy, the Directors elected for the ensuing year, 1909-1910, were called to order, and the following Officers were unanimously elected, to-wit:

William A. Spalding	President
William H. Knight	First Vice-President
John D. Hooker	Second Vice-President
Samuel J. Keese	Treasurer
Holdridge O. Collins	Secretary

The President appointed the following Standing Committees, viz.:

Publication.

Holdridge O. Collins, Chairman.	
Dr. Anstruther Davidson.	Dr. Frank D. Bullard.

Program.

William H. Knight, Chairman.	
George W. Parsons.	William L. Watts.

Finance.

Samuel J. Keese, Chairman.	
Bernhard R. Baumgardt.	Clement A. Whiting.

A meeting of the Directors was held on May 25, 1909, at one o'clock P. M., in room 625, San Fernando Building. Present: Messrs. Spalding, Collins, Davidson, Knight, Parsons and Watts.

It was decided to have the next meeting of the Academy, the last before the Summer vacation, on June 2, 1909, in Blanchard Hall. That admission shall be by tickets, of which each member shall have two, all others to be charged twenty-five cents for admission. As an illustrated lecture on Venice will be given by Mr. Baumgardt, Messrs. Knight and Watts were appointed a committee to see that publicity be given of the occasion by the city newspapers.

The invitation from Mr. Abbot Kinney for the Academy to hold a special meeting at Venice was accepted, and Saturday, June 19, was fixed for that event. The Secretary was authorized to consult with Mr. Kinney, make due arrangements, and give notices to members. The Secretary was also authorized to solicit advertisements for publication in the Bulletin.

Mary M. Bowman was admitted to membership.

Board adjourned.

JUNE.

The June meeting, 1909, was held in Blanchard Hall on the second of the month. Owing to a misunderstanding as to the rent of the hall for the evening, it was necessary to omit all business matters, as we were required to surrender possession at ten o'clock, and the Annual Reports of officers were not presented.

Announcement was made by the President of a meeting to be held on June 19, 1909, in Venice, at which the business of the past year will be terminated.

Mr. B. R. Baumgardt delivered an interesting and instructive lecture on Venice (Italy), illustrated by beautiful views upon the screen.

A meeting of the Academy was held in Venice on Saturday, June 19, 1909.

At 3:30 o'clock, P. M., in the Hall of the Venice Chamber of Commerce, on the Ship Cabrillo, the Academy was called to order by President Spalding, and an address of welcome was made by the Secretary of the Chamber.

The Annual Report of the Secretary was read and ordered to be printed in the Bulletin.

Dr. Andrew Stewart Lobingier delivered a very interesting discourse upon the "Economic Position of Public Sanitation," which was listened to with profound attention.

Short addresses were made by President Spalding, B. R. Baumgardt, Abbot Kinney, H. P. Barrows and William L. Watts.

After adjournment the members were entertained by Mr. Kinney with an inspection of the various places of amusement in the city.

A meeting of the Directors was held on Monday, June 28, 1909, in Room 625, San Fernando Building, President Spalding in the chair.

A resolution was unanimously adopted authorizing B. R. Baumgardt, who is about to depart for Europe, to purchase on behalf of this Academy, at least 400 slides for projecting purposes, and at least 400 photographs, illustrating Science, History and Art.

Professor J. Z. Gilbert was authorized to organize a Zoological Section, and the Secretary was instructed to communicate with Mrs. Erskine M. Ross, and request from her an allotment in her Rancho La Brea for excavation under the auspices of this Academy, in a search for fossil and geological specimens.

The Publication Committee was instructed to issue a Bulletin in July.

Mr. P. D. Barnhart and Rev. E. Stanton Hodgkin were elected members of the Academy.

Board adjourned.

On June 28, 1909, in Room 625, San Fernando Building, a Zoological Section of this Academy was organized by William A. Spalding, George W. Parsons, Professor J. Z. Gilbert, William H. Knight and Holdridge O. Collins.

Prof. Gilbert was elected Chairman and William H. Knight, Secretary, but Mr. Knight resigning, Mr. Parsons was chosen Secretary.

A meeting of the Section was held at the residence of Mr. S. J. Keese on Monday, June 12, 1909, at which Prof. Gilbert gave a statement of the progress in the excavations at the Rancho La Brea, made immediately possible by means of the generous donation to the Section by Mr. John D. Hooker. He placed upon exhibition several fossils, in an excellent condition of preservation, of long-extinct animals, which he had excavated at this place, and he outlined the plan for future work under the auspices of the Academy.

HOLDRIDGE OZRO COLLINS,
Secretary of the Academy.

ASTRONOMICAL AND GEOLOGICAL SECTIONS.

The Astronomical and Geological Sections assembled in joint meeting on Monday, January 18, 1909, at the residence of Mr. S. J. Keese, No. 1509 Shatto street, and listened to an address by Mr. W. H. Storms, Chairman of the Geological Section, on the "Auriferous Rivers of Calaveras County, California."

This night was the sixty-first anniversary of the evening when water was turned into the tail-race or ditch constructed for Captain John A. Sutter's mill at Coloma, El Dorado County, and in which James W. Marshall found the gold nugget the next morning.

The lecture was illustrated by lantern views, and a very graphic map of the ancient gravel channels, probably formed before the advent of man. These channels, which were covered from time to time by volcanic tufa—of mud and ashes—are superimposed, one upon the other, and have been exposed at depths of hundreds of feet, by the erosion caused by the tremendous rainfalls in the early life of this planet.

The Astronomical Section assembled at 621 Witmer street, on Monday evening, February 15, 1909, and the evening was devoted to general discussion of the philosophy and scientific religious thought of Persia and India. Mr. Norton Hazeldine, who has lived in India since an infant, and is conversant with the sanscrit literature and is thoroughly familiar with the systems of the various religious bodies of the Orient, explained the intimate association of most of the Eastern religions with scientific principles, more particularly as relates to Astronomy and Chemistry.

A very large number of ladies and gentlemen assembled in the apartments of Col. Eddy in Hillcrest for the March meeting of the Astronomical Section. The subject for consideration was "Life in other Worlds."

Mr. Knight, Chairman of the Section, conducted the meeting. An extended discussion prevailed as to the conditions for life in other planets, but the expressions of thought were not confined entirely to this channel, and diverged to the line of biology and a mixture of theological argument as to the origin of all life. The presentation of the subject by the materialist, the agnostic, and the theologian caused this meeting to be one of the most interesting and agreeable of the season.

HOLDRIDGE OZRO COLLINS,
Secretary of the Astronomical Section.

*Southern California
Academy of Sciences*

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OF THE
Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C. M., M. D. Frank D. Bullard, M. D.

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OFFICE OF THE ACADEMY
ROOM 625 SAN FERNANDO BUILDING

Southern California Academy of Sciences

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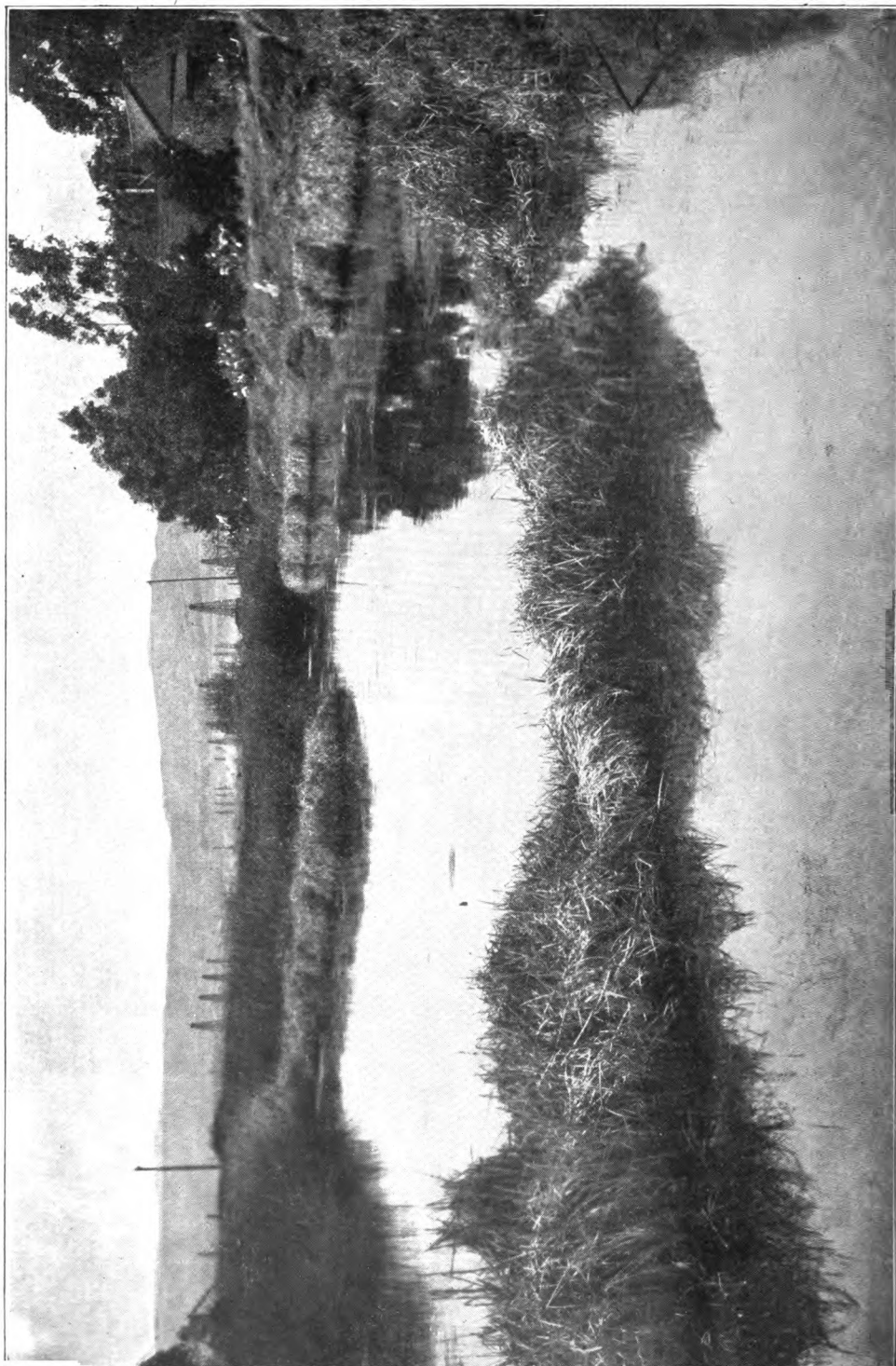
James Z. Gilbert, Chairman

George W. Parsons, Secretary

Botanical Section

Anstruther Davidson, Chairman

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The Lake of Asphaltum and Water and the old Hancock Home, Rancho la Brea.
Courtesy of Sunset Magazine.



Editorial

The article in this number of the Bulletin, by Professor James Z. Gilbert, Chairman of our Zoological Section, will be received with absorbing interest, not only by members of the Academy, but by all Scientific Institutions which receive our publications.

The wonderful deposit in La Brea Rancho of fossils of extinct fauna of the Pacific Coast has attracted the attention of zoologists throughout the whole extent of America, and so great has been the desire to secure specimens from this field, that the most noted Scientific Bodies in the land, from the Smithsonian Institution, through the long list down to the small College, have applied for permission to excavate in this unique store of treasure.

Mrs. Erskine M. Ross, the owner of the Rancho, imbued with the local patriotism of our Native Sons and Daughters, and thoroughly appreciating the value of these discoveries as illustrating the history of this region before the advent of man, has refused to allow these remains to be taken from California, and by her direction only this Academy of Sciences, the State University and the Los Angeles High School will be custodians of these fossils. This, as well, for the education of our youth, and the study by all interested in the geology and zoology of this State, as a memorial to Major Hancock, one of the earliest American settlers, and progressive citizens of Los Angeles.

In the early Spanish adobe life of Los Angeles, when lumber was an impossible factor, the roofs of the buildings were covered with a natural waterproof material, called Brea, composed of the dried or hardened mixture of asphaltum and sand or gravel. Upon the Rancho of Major Hancock, but a few miles from the city, were large deposits of this Brea, surrounding springs of water, side by side with the continual and bountiful flowing asphaltum. From this place most of the roofing material of the city was taken, and gradually a little lake was formed by the excavations, composed of water and asphaltum, through which the natural gas of the underworld

forced its way, giving the place somewhat the resemblance of a boiling pot. Today the visitor stands with wonder on the bank of this little sheet of water, as he listens to the constant bursting of gas bubbles, and witnesses the rings and ripples agitating its surface. The two large halftones in Professor Gilbert's article give a very fair view of this lake, and the effects of the gas issuing from its surface.

At places, in the old excavations, quantities so great, of bones were encountered that other points were selected for the work. The uninformed of those days, believed these bones to be the remains of cattle, horses and sheep which had grazed in the vicinity, and the place became known as La Huesamenta, or as we would say, "the bone yard."

In the year 1901, Professor W. W. Orcutt, now the manager of the Geological and Land Department of the Union Oil Company of California, while examining the geological conditions relating to the occurrence of petroleum on La Brea Rancho, found in the asphaltum beds a quantity of bones, some of which were of ordinary appearance, but others were so massive that they excited his curiosity. He made only a cursory examination at that time, but in the summer of 1902 he took from the brea bed a Saber of the Saber-tooth Tiger, and soon after he excavated the skull of a young Saber-tooth Tiger, the skull of a Wolf, teeth of the wild horse, fragmentary bones of Rodents, the bones or scutes from the skin of the gigantic Ground Sloth, water-worn pieces of cedar wood and several other fossils of a miscellaneous character.

These he kept in his office and exhibited to his colleagues and personal friends. In 1907 Mr. F. M. Anderson, Geologist of the Southern Pacific Company, in an examination of this collection, was so impressed with the importance of Professor Orcutt's discovery, that he informed Professor J. C. Merriam of the University of California, of the existence of these deposits. Professor Merriam immediately entered into correspondence with Professor Orcutt, which resulted in several visits to these Brea beds, and, securing permission from Mrs. Hancock, now Mrs. Ross, in the winter of 1907-8, with his assistants, he excavated several rare specimens which are now in the Zoological rooms of the State University at Berkeley; and the first public announcement of the discovery of this, the greatest deposit of its kind the world has known, was given in Professor Merriam's paper, published in the *Sunset Magazine* of October, 1908.

The large appropriations made by the Los Angeles City Council and the County Board of Supervisors, and the results achieved in these excavations speak louder than anything we

can say regarding the work of this Academy of Sciences, and the influence it exercises in the dissemination of scientific information throughout this community.

Our Board of Directors has entered into a contract with Los Angeles County whereby one wing of the great Historical Museum and Art Gallery, now in process of construction in Agricultural Park, will be placed under our control, and in this building will be deposited these invaluable fossils, our constantly increasing Library of over two thousand volumes, and our collections in Botany, Geology, Ichtheology, Conchology, Ethnology and Zoology, which will be freely placed before the public for examination and study.

Last summer while taking his vacation in the San Bernardino Mountains, Dr. Anstruther Davidson discovered a new species of the Mariposa Lily, one of the most beautiful of the wild flowers of California. The name Mariposa was given to this flower by the early Spanish settlers, who saw its resemblance to the wings of the butterfly in the exquisite arrangement of its variegated colors. It is found on the foothills and in the cañons of the mountains during the Spring, before the moisture has disappeared from the ground. Dr. Davidson has named his new Botanical find *Calochortus paludicola*, and a technical description of it is given herein.

Professor George E. Hale, Director of the Mount Wilson Solar Observatory, announces that the details of Mars are perfectly natural, with no evidence of artificial structure.

In 1877, Schiaparelli first saw the markings upon Mars, which he called **Canali**, and during the opposition of 1879 he announced not only the discovery of additional **canali**, but the strange condition of their gemination. Unfortunately, the term **canali** was translated into English as canals, when it should have been channels, rifts, gorges, or cañons, for, in 1893, he stated that "it is not necessary to suppose here the work of intelligent beings, and in spite of the almost geometric appearance of their whole system, for the present we incline to believe that they are the product of evolution of a planet."

From continued observation during the next four years, his opinions concerning these **canali** changed, and in his memoir of 1897, published by the Reale Academia del Lincei, he says: "This whole arrangement presents an indescribable simplicity and symmetry which cannot possibly be the work of chance."

Upon the announcement of Schiaparelli's discoveries, astronomers all over the world proclaimed their inability to find these markings, and they charged that Schiaparelli had been the victim of an hallucination; others, although clearly detecting these markings and even drawing them, asserted they were "illusions due to the property of light itself, the inability of the eye to maintain its mechanism of accommodation, the behavior of air waves, temporary alteration of the focus of the eye, undetected astigmatism," etc., etc., but in 1886 Perrotin and Thollon, of the Nice Observatory, emphatically confirmed the existence of these **canali**, and now they are recognized everywhere by astronomers.

Professor Percival Lowell, from his Observatory at Flagstaff, Arizona, has devoted many years to the observation and study of Mars, and Professor Schiaparelli heartily concurred in his conclusions from the results of his investigations. Professor Lowell announced that on September 30, 1905, "two striking canals became evident where no canals had ever previously been seen. The present phenomena show that the canals still are in process of creation; that we have actually seen them formed under our very eyes. The phenomena transcend any natural law, and are explicable only so far as can be seen, by the presence out yonder of animate will."

On December 29, 1909, before the British Astronomical Association, Professor E. W. Maunder, Superintendent of the Solar Department of the Royal Observatory at Greenwich, evolved the following pronouncement: "Nobody has ever seen a single canal on Mars. There has never been any real ground for supposing that the markings on the planet supplied any evidence of artificial action. It were better for science that the canal theory be abandoned completely."

And now comes Professor Hale, who says that during the recent close opposition, his great 60-inch Reflector "showed no traces of the geometrical network of narrow 'canals' described by Lowell. The extremities of the Sabaeus Sinus and the adjoining parts of the Schiaparelli 'canals,' Gihon and Haddekel, were seen to be broad and irregular, very unlike their appearance in Lowell's drawings. During the periods of best definition, when a power of 800 was required to show the smallest details, they were resolved into minute, twisted and broken filaments, not fluctuating in position, but definite and unmistakable in character. Another 'canal,' though not thus resolved, differed more markedly from Lowell's representations. Instead of continuing for a great distance as a narrow straight line, it terminated abruptly, the irregular shape of the extremity being plainly seen."

In one of his Epistles, Pope asks,

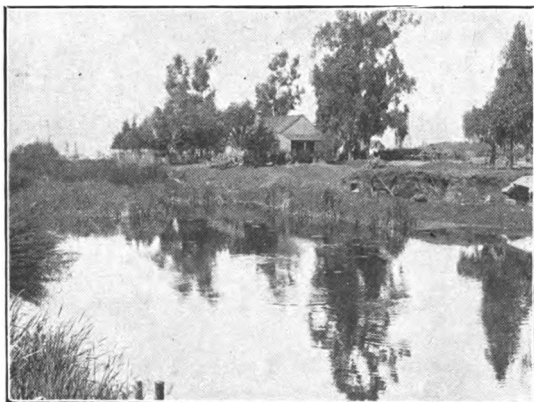
"Who shall decide, when doctors disagree,

And soundest casuists doubt, like you and me?"

A cablegram from St. Gobain, France, has brought the gratifying news that the glass disk for the 100-inch Hooker Reflector, has been successfully cast. It will start upon its long journey so soon as it can be securely packed in its iron case, and upon its arrival in Pasadena, Professor Ritchey will immediately commence its grinding, polishing and figuring with the new machinery by him devised. This labor, and the construction of the new housing and mounting upon Mount Wilson, will require about three years, and an expenditure of half a million dollars, but we can await patiently the completion of an undertaking nowhere paralleled on our globe, and such as the most vivid imagination of mankind has never heretofore conceived.

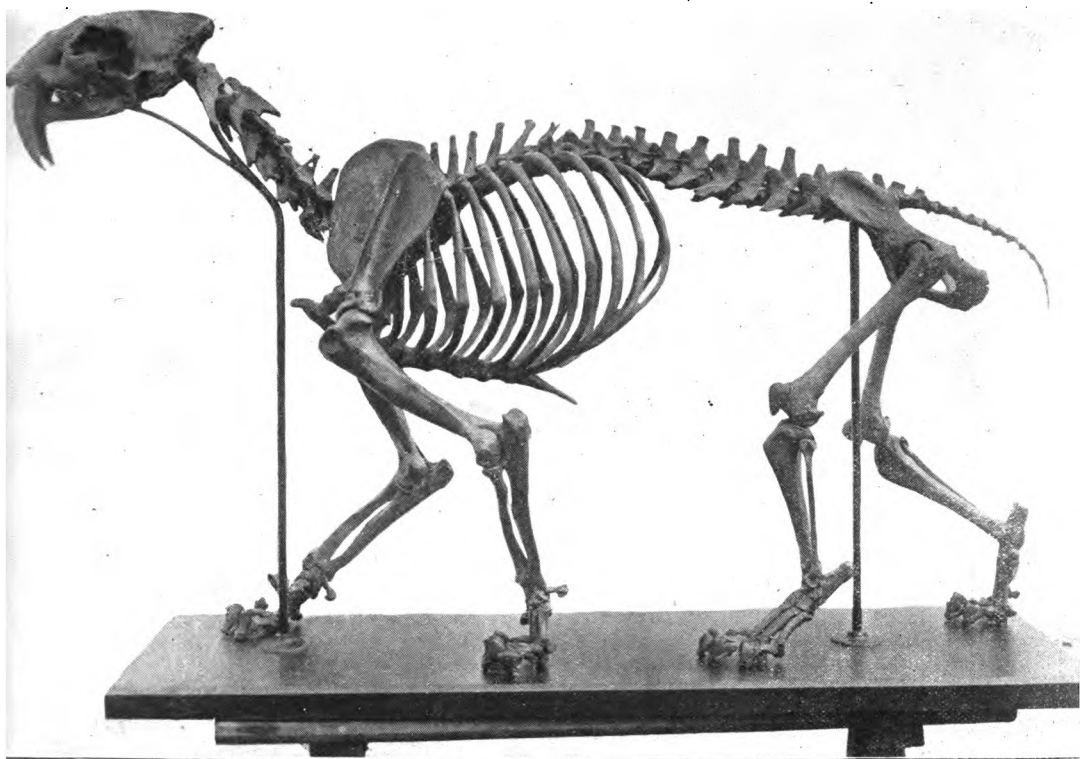
The large amount of matter in this number of the Bulletin has expanded its size so far beyond the usual dimensions that the record of the Transactions of the Academy is necessarily omitted. It will be included in the Bulletin for July.

Holmden Ogra Collins.





MRS. ERSKINE MAYO ROSS.



Skeleton of Sabre-tooth Tiger, excavated at Rancho la Brea.
Mounted by Eugene Fisher.

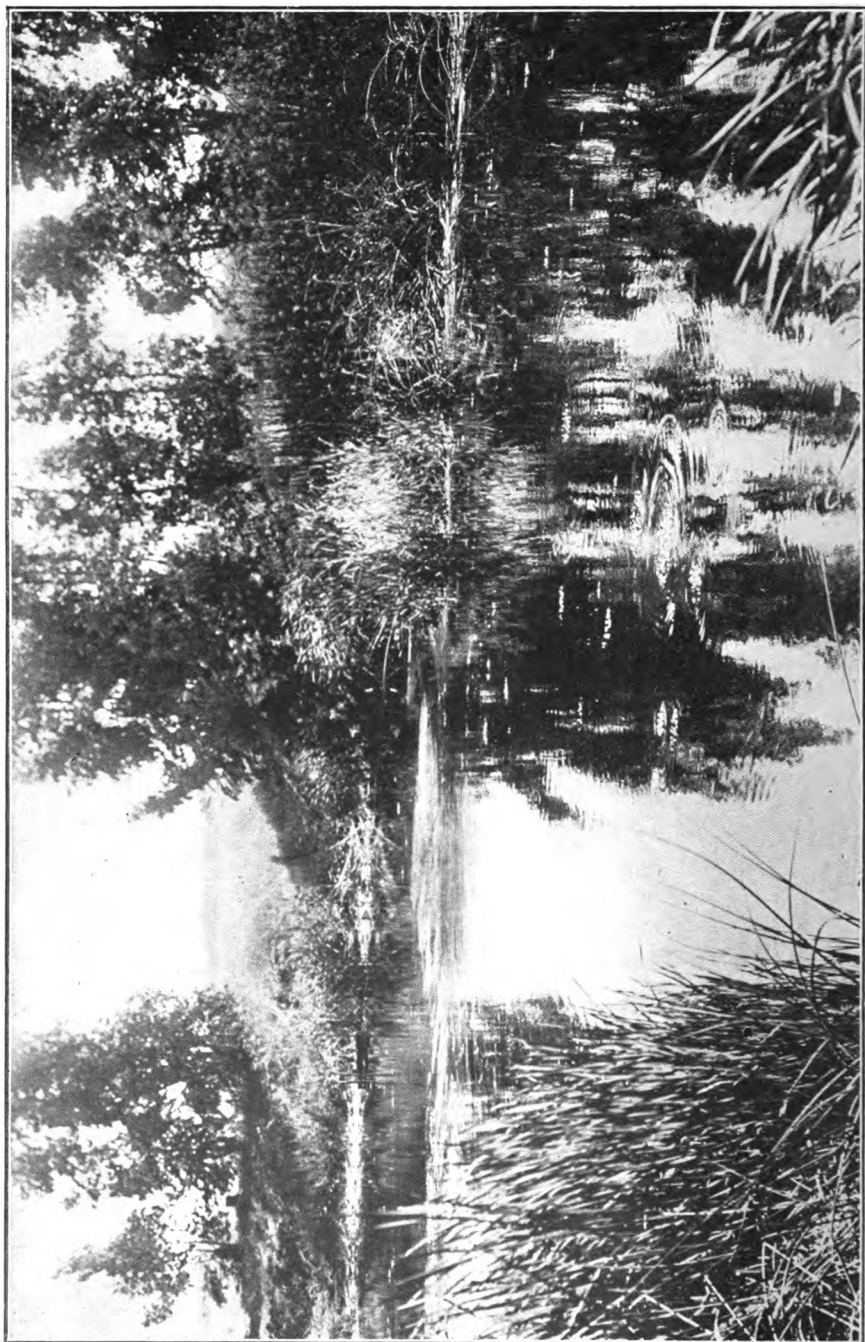
The Fossils of Rancho la Brea

By James Zacchaeus Gilbert.

It is not the purpose of this article to give an elaborate and exhaustive treatise of the treasures unearthed on Rancho La Brea, for this would require volumes, but to present in a brief, simple manner some of the most salient features of public interest in the work thus far done, and the finds thus far made.

In June, 1908, Mrs. Erskine M. Ross, whose photograph appears in this issue, gave to the Southern California Academy of Sciences the privilege of excavating the fossil material found upon her ranch, whereby our residents and thousands of visitors have had the opportunity to examine the most remarkable fossil bed of its kind in the world.

The Pacific Coast, geologically speaking, is a comparatively young region, and presents for investigation rare deposits of fossil material. These range from the Miocene upward, and such large exposures occur



The Lake showing ripples of the bursting gas bubbles.

on this slope of the Continent that it has come to be regarded as a very rich field for the paleontologist.

In fact, the Pacific Slope is recognized the world over as one of the very richest fields for the study of life during the geological periods. So thoroughly has the great region been studied and carefully searched that to find a deposit of such rare treasures as are entombed in the asphalt beds at Rancho La Brea, and this, too, almost within the limits of a great city, is truly a happy surprise. The more remarkable is it since the deposit area is beyond compare. The forms are unique, most thoroughly preserved, and readily accessible.

This place has been known for its "tar" more than a century, and the strange bones have been repeatedly reported locally, but the Government Survey and reports contain not a word about them. The fossils seem to have been regarded by all as the remains of ranch animals, and of the hundreds of domestic animals which have perished every year since the first Spanish missionary set foot on this virgin soil. Even so keen an observer and so careful a writer as Mr. Whitney, the State Geologist, whose report appeared in 1865, regarded these bones as being those of wild domestic animals. He describes the bony deposit as "a very large amount of asphaltum, mixed with sand and the bones of cattle and birds which have become entangled in it."

The earliest known record of this tarry deposit is that of a Spanish padre missionary, who reported it in his notes of exploration in 1769. He mentions in his diary the tar and the use of it for calking of canoes, and for roofing purposes. Little attention was paid to this deposit, except that the natives and the settlers used it for fuel, roofing and paving. The roofs of the first adobe houses built in Los Angeles were covered with asphalt from La Brea springs. From that early day until 1863 there is little mention of the Brea beds.

A large area of some 5000 acres was owned by several Spanish grantees, from whom the land was purchased by Major Hancock, the title subsequently being perfected by Senator Cole of Washington, who afterward came into possession of a thousand acres of this land around the present site of Colegrove. Major Hancock in 1853 made a second survey of Los Angeles, known as the Hancock survey. After the Civil War the development of the asphaltum deposits on the Rancho La Brea was begun. The Major developed the use of the asphalt for sidewalks and paving purposes, and shipped considerable quantities to San Francisco by schooner. This asphalt was also much used for fuel by the early Los Angeles manufacturers. It was during this Hancock development, in addition to that previously made, that the artificial lake, "The Pit," was formed by removing large quantities of asphaltum.

In 1883 Major Hancock died, leaving his wife with her little family of three to bear the misfortunes of widowhood. In her sorrow for loss of companionship, her anxiety on account of the perplexities of large financial plans, she left the city and sought the quietude of a home on the ranch. Here she reared her little ones to lives of honor, and even now, the buildings, nestled among the trees by the side of the pool of such marvelous treasures, are suggestive of peace and quietude, industry and thrift.

With a more luxuriant vegetable growth, a more semi-tropic climate, a more abundant rainfall and perchance a slightly lower altitude, this place was the scene of those bygone days when animals, prodigies in size, vast in numbers, great in variety and remarkable in development, lost their lives and left their bones to rest through past ages in the tarry springs.



A Lecture on Zoology in "the Pit."

In 1875 Mr. Wm. Denton received from Major Hancock one of the very large sabers of the Saber-tooth tiger. Thus the Major was doubtless the first one to observe the peculiarity of these bones, and recognize them as belonging to extinct forms.

On further inquiry the writer learned that Mr. W. W. Orcutt, secretary of the Union Oil Company, was the first geologist to consider the bones of this deposit as being really prehistoric.

The deposit on Rancho La Brea has been variously styled La Brea Beds; The Death Trap; The Fossil Gardens; The Asphalt Beds; The Bone Field; The Pit; Rancho La Brea Beds; Rancho La Brea Formation; La Brea Pleistocene Beds; La Brea Pleistocene Formation, etc., intended to designate the deposit of bones in the tarry pits on the Hancock ranch. All these designations, each suggesting an element which should be in the name, lack very essential particulars. A name should include reference to the greatest deposit of its kind, the location, and due credit to any person directly concerned in its discovery. In view of these three essentials, and by the consent of the owner of these deposits, I have used the name, The Hancock Brea Deposits.

Up to date the most extensive explorations have been carried on by the Southern California Academy of Sciences. This Academy, wholly in the interest of free educational advantages for public good, has secured a very great quantity of most excellent material, which forms the chief subject-matter of this article, and the results of its labors will be placed before the public in the large and convenient Museum now in process of construction.



Two active Asphaltum Springs in a corner of "the Pit."

According to Geological Reports, this deposit is well designated as Pleistocene, or early Quaternary, and a portion of the great Elysian Park anticline. From this anticline there extends a special formation

of a divergent subordinate fold along the fracture line or axis of which the escape of gases occurs. The general trend of this axis is nearly east and west in the region of the deposit, which is bounded on the north by the Santa Monica Hills, and on the south by another gently rising anticline. It dips so abruptly southward into the productive area of oil just north of the brea beds, that at less than two miles to the south of the field no well-paying oil sand has been found, even at a depth of 5320 feet.

The various changes in elevation of the Pacific Coast have produced changes in the conditions of erosion and deposition, resulting in an environment more or less favorable to the development of plant and animal life. Evidences are abundant to show that at one time in the history of the southwest this area was lower and more marshy; the climate was milder, the rainfall more abundant, vegetation more luxuriant, giving rise to a correspondingly highly developed fauna, and support to a greater variety of forms. This semi-tropical condition was succeeded by a rise of the land, the fall of temperature, and the "ice age" or glacial epoch was ushered in. The snow and ice extended far to the south, especially in the higher altitudes, and gave the death chill to the life of the pre-glacial or Pleistocene time.

It was at this time, about two hundred thousand years ago, that the plants and animals of Rancho La Brea perished and were buried. The subsequent sinking of the land resulting in the change of rainfall and temperature, brought about the melting of the ice, and introducing the present age. The slighter subsequent changes of level, both local and general, have caused many local disturbances, and it is suggested that the breaking and scattering of the bones in the Brea deposit have been due to such causes, but this is without evidence in the beds themselves. In fact, the general miring of animals and the scattering of their bones by carnivores, and the drifting by water, followed by the natural settling of the deposit in such accumulations, are quite sufficient to account for all changes noted.

The very remarkable number of vents through which the gas is constantly escaping all over this area in and around the Brea deposits, suggests the probability of another line of fracture, composed of numerous disconnected minor direct and reverse faults, extending southwest from the subordinate flexure, and, just as the fault zone along the line of the sudden dip, referred to above, marks the northern boundary line of the richest productive area, so the abundant escape of gases along the line of the Brea beds suggests another line of fracture which may reach the southern limit of the productive field. Strength is given to this idea by the logs of the wells in the area south of the beds, which show oil seeps at various depths, but in no paying quantities. The failure of the deepest well to find a profitable basin of oil sand indicates broken strata filled with joint cracks, giving rise to slight displacements and tiny fissures. If this surmise be substantiated, then there is little hope of finding much oil south of the Brea deposit region. The Tar Springs have formed no insignificant part in the role for the accumulation of oil, tar and water throughout the whole mass of material. Thus as the materials were forced upward by great pressure, the gas carried the oil, tar and water with it. This mixture impregnated the previous beds of formations, making local oil and tar lakes, until finally in the upward course, reaching the top of the vent, tar springs and lakes naturally occurred on the surface. The bursting gas bubbles left tar-lined cavities of varying dimensions, which soon became filled with water, and the seeping oil saturated the ground, rendering the subsoil quite soft and sticky.

The consistency of this tar varies from a light miry liquid to a very heavy almost solid, immovable mass, which on drying becomes so flint-like as to turn the points of a pick. The condition varies much with the change in temperature, hence specimens in the bank which would be removed with difficulty in the morning, when heated by the noon-day sun would fall out. The springs too, become more active in the summer season, and in the afternoon of each day. At the time of greatest activity the bubbles are smaller and more frequent, while at other times larger and more massive.

The "stick-tu-at-iveness" of this material is evident from what has been said, and those who work in the beds understand it perfectly, for the clothing becomes covered with tar, and layer upon layer improves the durability of the garments so much that a second pair of shoes is not needed. Then, too, there is no need for rubber boots nor leggings for the penetrating tar fills the fabric, rendering it perfectly impervious to water. This sticky mass prevents water from entering the pit, though the digging is now about ten feet below the level of the lake. The penetrative power of this asphalt-bearing oil is so great that there is not a substance, clay, sand, wood, or bone within several feet of the spring that is not thoroughly impregnated with the tar; and it slowly oozes from the long bones for weeks, if they are not opened and cleaned or thoroughly soaked in coal oil and rinsed in gasoline.

The surface layers of varying thickness from the pure glistening tar to the hard asphalt pavement, are formed by the evaporation of the volatile ingredients. These, in connection with the dust and drifting sands carried by the winds, make a deceptive covering for the spring, causing it to appear firm and strong. The quantity of water in the cavities, or the scanty "salt grass" which grows around these springs are quite tempting to a thirsty or starving animal. The bait is thus placed and the trap is set.

It is thus easy to see how an animal wandering in the twilight in search for food and drink would in the extremity of famine be driven to partake of the last lingering remnants of food. When once the feet begin to sink into the sticky mass, while quenching the burning thirst or satisfying the gnawing hunger, they could not be withdrawn, and hence while the animal would try to release one foot the other would be forced downward the farther. Deeper and deeper until limb and body, neck and head are completely submerged, or perchance in the struggle only the nostrils are closed with the tarry mass and death by suffocation ensues, or it may be from sheer exhaustion the animal yields to the inevitable and groaning, sinks to the ground limp and dying. Again, it doubtless occurred that an animal caught, either cried for help or out of distress, and thus attracted the preying beasts. It was then that a horrible feast followed when the lion, the tiger, the wolf and coyote, alike trained to the piteous cries hastened to the scene to satiate their appetites while the killing was being done. The tiger drank the blood; the lion quickly found the great deep muscles, the wolves and coyotes were content with the smaller parts, and quickly the unfortunate creature was torn asunder from limb to lung and scattered in every direction. Judging from the way the bones of the same skeleton are distributed in the deposits the parts which would otherwise have stood upright in the mire, were pulled from the tar and greedily devoured. The many gnawed bones suggest the great scarcity of food, while the interlocked jaws and broken teeth and scarred skulls tell most vividly of the frightful struggles which went on.



The Mastodon and Saber-tooth Tiger of the Quaternary Age.

On one occasion two skulls were found with the jaws interlocked and the teeth broken at the place of contact as though the animals, both victor and vanquished in the fiercest of the strife died together. In this way the feast was constantly renewed. With the nightly feast completed and the participants remaining behind, or in safe retreat to the mountain fastnesses or in the neighboring jungles, the day would bring another group to the ready meal. The condors, hawks, eagles and vultures, larger and more fierce than those of today would gather here and feed to the full their rapacious desire. These, too, though generally cautious, would be at times off guard and unmindful of the treacherous tar, they would sink a foot, or dip a wing, or touch the tail and add another specimen to earth's museum and record another witness of the life that once lived here, but could not survive.

There is one other way in which some bones came to be in these chimney-like holes of deposits and that is by drifting in from the plains in flood time. These carried along by shallow water would be readily caught on the tarry masses which accumulated around the springs then covered with drifting sand during drouth and impregnated with oil.

These pools of tar when not strewn with debris or covered with dust and sand but fresh with the flow, appear in the twilight or the shadow of night most remarkably like water and give the same reflection from the mirror-like surface. The deception is perfect and almost daily, insects, snakes, birds, mice skunks, rabbits, etc., are being caught. On one occasion a skunk started along a smooth dust path across a circular area, but it had proceeded only about three feet from the edge when further progress was impossible. The surface was soft, the feet stuck fast and in a day or two only the white tip of its tail remained above to tell of the fatal event. Another night scene is illustrated by Figure 1. A beautiful burrowing owl



Figure 1.

lured by the glassy surface of a pleasant pool, dropped into the water as it supposed the liquid to be, for a drink, but alas the wretched deceit. With fastened feet and outspread wings, a sinking breast and a buried beak, the struggling bird perished. Another event evinces the deceptive appearance of these tarry places. This is shown in the pathetic picture of a swallow whose, "skimming-the-brink" instinct urged it in the shadowy evening to try the shining pool. No sooner did its downward sweep strike the oil than the wings both tipped, the tail dragged and not a limb could be moved. And in Figure 2 we see it on its bier.



Figure 2.

One day when showing some visitors the field, a black looking snake came slowly along my path. I stopped in wonder at its queer movements. On examination I found its eyes were completely closed with the tar and its body covered. It proved to be a king-snake and was so emaciated by starvation and weakened from exhaustion, that it lay on my hand perfectly still. Another, a gopher snake, was found badly smeared with tar which being removed by a bath in coal oil and gasoline, the poor creature was set free. Numberless instances could be cited, but space forbids. Suffice to say, that a linnet, a lark, a crane, a duck, a squirrel and many others were found just caught or dying, decaying or leaving only traces of the whitened bones bleaching in the hot summer sun.

According to the record of the ranch managers and the neighbors, the trapping of barnyard animals is no uncommon circumstance. On one occasion a fine horse of three years, frightened by a passing automobile rushed across the field and ran unwittingly into one of these tar pools. When the owner discovered it, it had sunk to half way up its sides in the mire. All efforts to extricate the beast were in vain until a traction engine, passing by at the critical moment, was pressed into service. With a rope around the horse's neck, and with a long steady pull the animal was rescued, but it was not until with great labor and patience in applying gasoline that the colt was made respectable.

As these skeletons were deposited from year to year during the centuries, thousands doubtless wasted away and appear only as decayed animal matter, while others, thoroughly preserved by the tar, remain to the present almost as perfect as recent bones. These fossils are not petrifications as in most other cases elsewhere, but are the real bones, unchanged except in loss of animal matter and in their discoloration caused by the tar. This discoloring, however adds to, rather than detracts from their beauty, for when polished they shine like the best of old bronze.

The fossil vegetable forms also suffered the same fate and appear



Fossil Cypress.

in broken fragments of leaves, twigs, limbs and trunks of trees as well as of seeds and cones. These all appear as debris and nothing is in situ. The larger amount of the material seems to be that of live-oak, cedar and pine. The species of which have not been worked out.

These bones and vegetable remains have been thrown together in such confusion as to render the removal of them very tedious and difficult. The bones are so mingled that two consecutive ones are rarely found together. But sloth and tiger, mastodon and wolf, bird and beast, in fact some part of more than twenty animals may be found in a few cubic feet of space.

To remove these, requires very little use of pick and shovel, but a great deal of painstaking labor with small tools, such as a garden trowel, flat file or a crooked wire. In this way often much less than a spoonful of the tarry matrix is removed at one time. Then too, while attempting to lift a certain desirable bone, a dozen others



Figure 3.

crossing it in one direction and another, (Figures 3, 4) must first be most carefully taken away. This is very trying on one's patience, for it is not uncommon to begin in the morning on a certain bone and by night be, apparently farther away from it. On one occasion a member of the Board of Education came from the city to witness the digging, and decided to see a certain camel bone, plainly in sight, taken out. The digging for this bone began at 9 a. m. and it was exactly 2:30 p. m. when the coveted prize was placed in his hands.



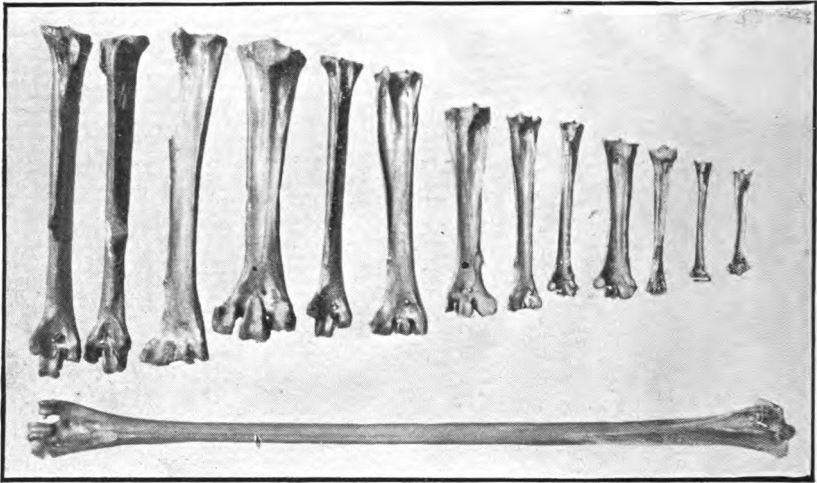
Figure 4.

While it took so long to secure the release of this one bone, there was a bushel of others taken out, which were too good to throw away and in truth probably as important as the one so eagerly sought.

The insect life of the beds is quite meager, consisting of only a few Myriopoda and Coleoptera. In most cases only fragments remain, the antennae, mouth parts, and legs having been lost.

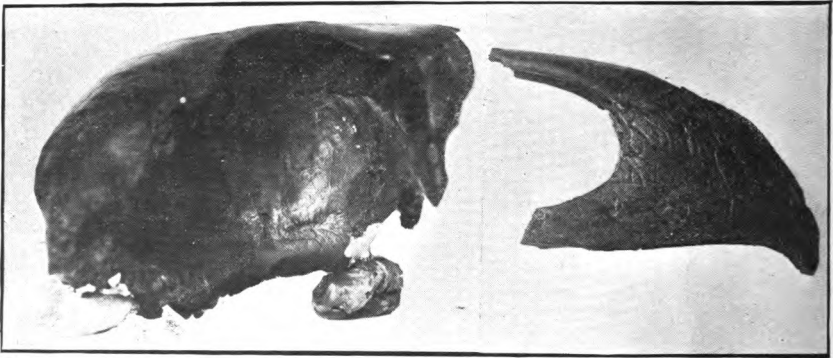
The only reptile represented is a turtle, of which only fragments of the Carapace have been found. The animal was small, about five inches long. Its specific identity remains to be determined later. Only one turtle was observed living in the lake upon the ranch.

That the birds should be represented in the fossil beds in great numbers is no surprise, for, when it is considered that during this period, birds of prey were numerous, they would be attracted to the remains of animals caught. The deceptiveness of the tar pools is so perfect, that birds of today are caught just as in ages past. Meadow larks, herons, bitterns, hawks, etc., are caught every season in great numbers. The skeletons are very incomplete, and the merest traces of small passerines are found. This last fact, however, is explainable on the ground of there being no attraction in the pools for them, and the few that might wander here might have been devoured, or have been destroyed in the motion of the tar, due to rising bubbles. Their bodies being small, they would not be caught except in the softest tar. The list of birds thus far identified includes the turkey vulture, golden eagle, western black vulture, California condor, raven, red tailed hawk, marsh hawk, barn owl, long eared owl, short eared owl, great horned owl, burrowing owl, Canada goose, great blue heron,



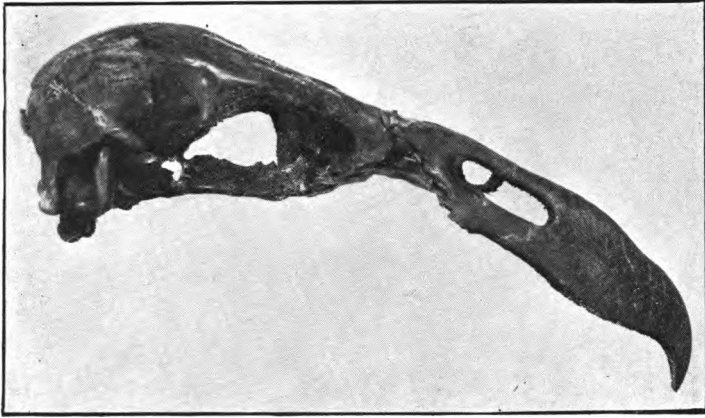
Shanks of various extinct birds.

stork, crane, pheasant, California peacock, a new condor and *teratornis merriami*. That peacocks should be found here, is remarkable since this bird is known only in the old world. There are doubtless several species of these, as the material at hand shows a decided difference in structure. The *teratornis* named by Mr. Miller is the very largest bird thus far determined. It was larger than any of our present condors and was a large sailing bird with a strongly compressed, hooked beak and very deep.



Skull and Beak of California *Teratornis*.

The birds evidently survived the ordeal of extinction suffered by the mammals, since so many of the forms found are yet living. This is what might be expected, since the birds are more readily capable of migration, and the amount of their food required is comparatively small. A glance at the list reveals the great preponderance of the flesh eaters, which is to be expected, since so many chances were offered to feed upon the dead carcasses of the mammals, caught



Skull and Beak of extinct California Condor.

in the tarry beds. Some of these birds while eating would, themselves, in one way and another be caught in the tar, only to become food for those following them. The scattered bones of these birds were preserved in the narrower springs, which in the accumulation year by year, resulted in chimney-like deposits with layer upon layer.

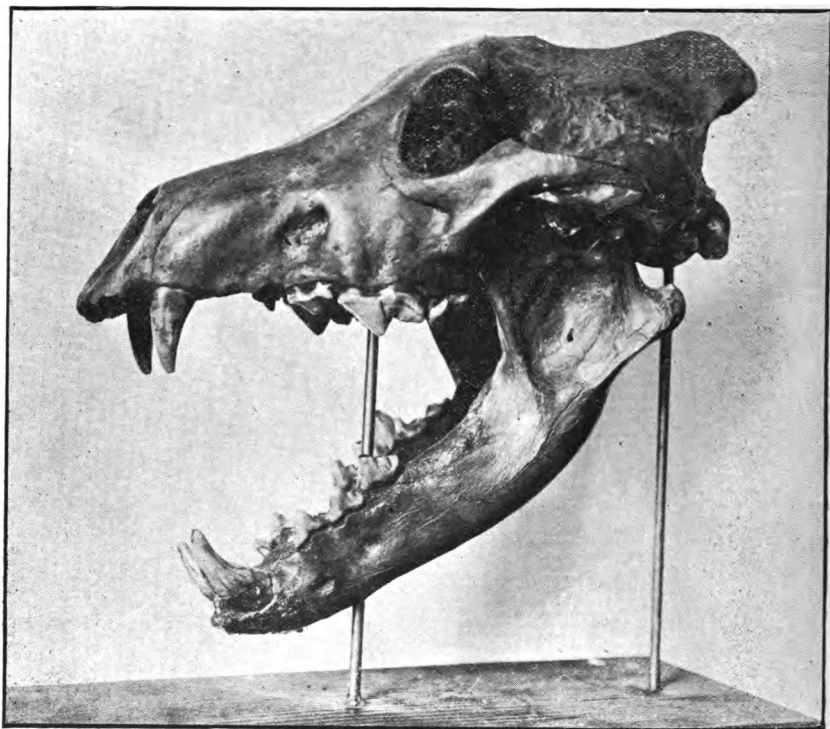
In spite of the fact of the survival of many forms, quite a number of the species became extinct in the crisis of unfavorable circumstances. The cause of extinction was doubtless that resulting in the death of the mammals, race decay and starvation. Just as species of birds are fading from the earth now, so *then*, the animals upon which these large raptors fed perished and they also disappeared.

Whence came the peacock? This bird, closely related to the turkey, seems to have appeared first in the rocks of India, whence ages ago it began to spread westward, reaching parts of Europe, north through Asia and east along China and Japan. Crossing the Behring land bridge it came down our coast in time to appear here in our beds in early Quaternary times. Other finds elsewhere are anxiously awaited, for the migration of the peacock looks strongly toward Asiatic origin. It must be held in mind however that migration was in those days possible toward Asia from here, as was the case with the camel.

If numbers found count for determining the dominant type, the golden eagle was by far most numerous, followed by the black vulture and turkey buzzard, alike plentiful, and the California condor making about 10 per cent of the whole, while the largest bird of all, was rather rare being about 5 per cent.

Among the mammals represented in the beds, the carnivores greatly outnumber all others. Judging from the individual skulls found, 75 per cent are carnivores of which 66 per cent are saber-tooth tigers, 20 per cent are wolves, 5 per cent coyotes 4 per cent lions, 2 per cent fox and the remainder other forms.

Of the herbivores, 45 per cent are giant ground sloth, 20 the American ox, 12 the horse, 10 the mastodon, 5 the camel and the remainder, traces of elephant, deer, etc.



American Giant Wolf. *Canis occidentalis*.

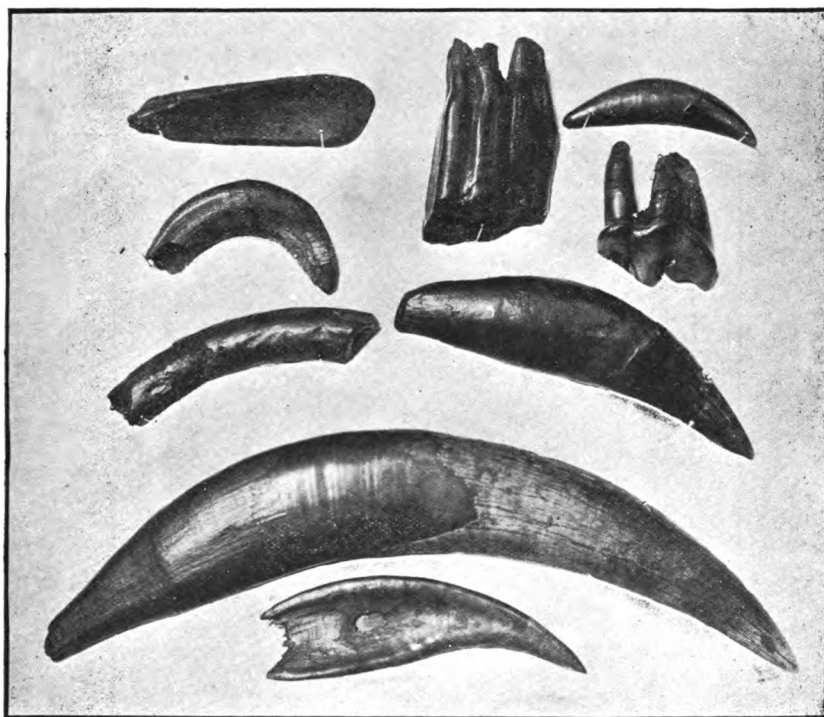
The canine group is represented by the wolf, two species, the coyote, the fox and the domestic dog. The coyote and wolf are extinct, but the fox is quite likely our living gray species. The great wolf was an exceedingly large one, even excelling our largest living specimens. Judging from the strength of the bones it must have been more clumsy and less fleet than our coyotes. Of this wolf, little has heretofore been found, except a few teeth which were discovered in Indiana and Texas. Here in the brea beds the bones are numerous. Sufficient numbers have been unearthed to complete several entire skeletons.

The smaller species, much fewer in number, are close relatives of our timber wolf of which there are probably only varieties.

The coyote is new, but it may have been ancestral to our present form. The fox was a very small one and was perhaps the individual ancestor of our present-day gray fox, or maybe only a variety of the same species.

The dog family, like the cat family has had a very wide distribution. It is found in every part of the world, as well as in fossil forms.

The fossil remains antedate man by several geologic ages, and are distributed in every continent. South America has no representative true wolves except the Falkland Island wolf, and, since the fossil forms are very recent, the dog family must have come down from the north over our country and wandered to the southern extremity of the new world. On their way a few were caught in the tar and died. Since the dogs of Australia have left fossil remains, there they certainly must have migrated from Asia, while strange enough, one extinct dog of South America resembles in the parts of the skull our domestic dogs and is especially allied to our coyote.



Teeth of Llama, Horse, Giant Wolf, Camel, Sloth, Lion, Saber and Milk Saber of Saber-tooth Tiger.

One of our fossil wolves is identified as *canis indianensis*, the Indian wolf of Arabia. This fact gives us a very striking incident of migration and contemporaneous development. Southeastern Asia is regarded as the original home of the family, and to find in Arabia the same species as we dig up here in our beds is indeed remarkable. The migration westward, landed them in Arabia and northeastward, into our continent by way of the Behring Strait. That these two branches should have retained their identity through the centuries and through such varied conditions as were found in this long migration, is astonishing.

Perhaps the very most remarkable group of animals found in the brea beds is that of the cats. The representatives found here are the great American lion and the saber-tooth tigers. The former is remarkable for its rarity, while the latter is wonderful in its abundance. In the collection so far made, more than fifty per cent of the mammal individuals are the tigers.

To date as many as fifty individuals have been represented by skulls and other parts. In every digging their bones are found, and eight skulls beside many other bones were excavated in one single cubic yard of earth. This tiger is the chief representative of a group of the cat family in which the upper canine teeth have shown a tendency to elongation, and of all cats of all times and of all places, this one was the strongest and most highly specialized. This specialization is in the sabers which extend below the jaw in some cases as much as seven inches. These canines develop through many generations into long thin, strongly recurved, saber-like teeth, with a sharp cutting edge fore and aft. Figure 5.

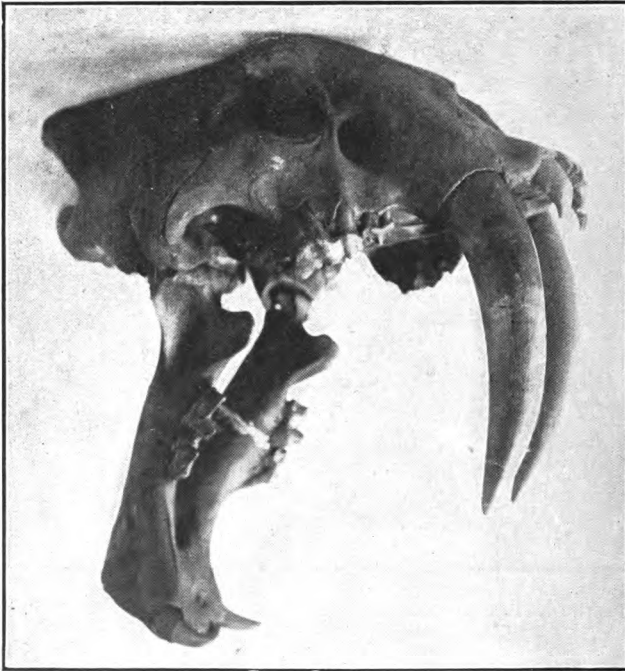


Figure 5.

The cat family presents three great groups in its past history and each group has its saber-tooth, but in none did the development proceed so far as in the true cats where our marvelous form of the Brea occurs. The earliest known cats appear in the Eocene of France, while in America they appear first in the Miocene of Nebraska and Colorado. Following these, were the false saber-tooths of middle and upper Miocene of Oregon, one of which was about the size of a panther and had a saber, but this was very weak and thin laterally and lacked the serrated edges.

The next showing progress, was a small cat called *dinicis cyclops* about the size of a Canada lynx and it had a saber-tooth long enough to reach to the inferior surface of the lower jaw, but instead of passing downward outside the lower jaw, it pressed down into a deep socket, specially developed to receive it.

Then came a small cat, found in Oregon, having a saber the shape and size of a shark's tooth, flat, broad at the base, serrated and coming quickly to a point. This was doubtless deciduous, as are the milk canines of our specimen, Figure 6. Another from this region

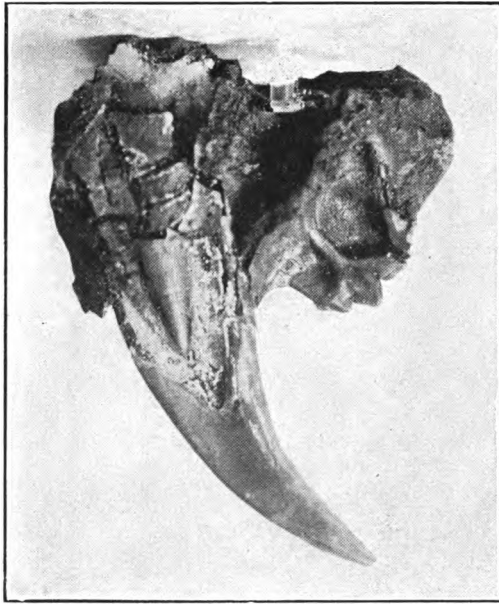
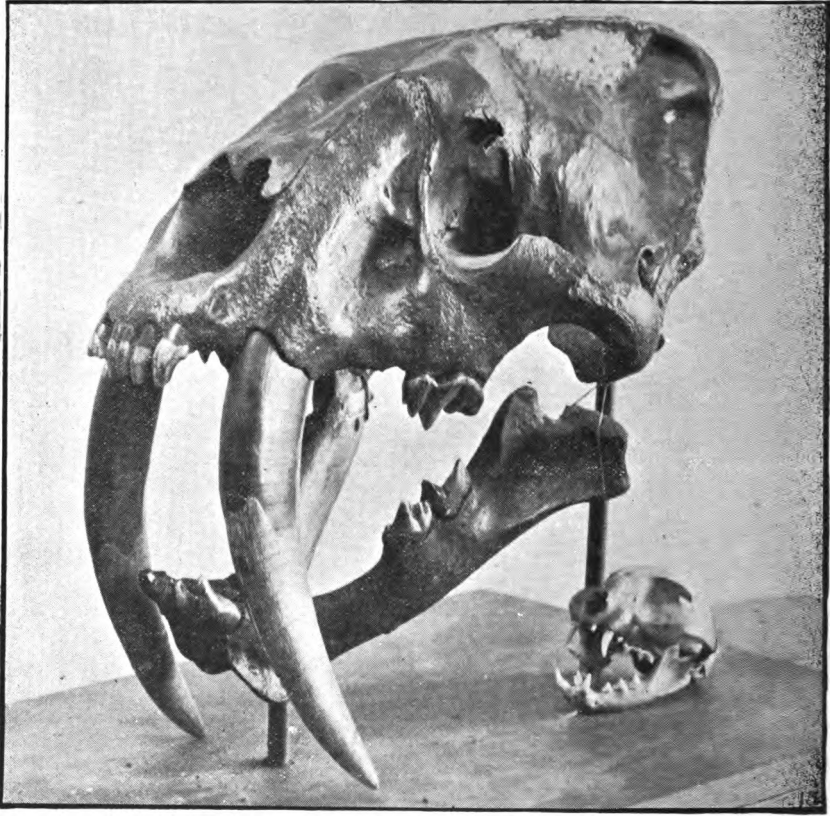


Figure 6.

of which only a skull is known, was a tiger-like cat approaching the size of our living types, and presented a saber which passed outside of the lower jaw as in ours, but the sabers were not nearly so long, reaching only to the inferior surface of the mandibles, while in ours they reach as much as three inches below.

Another species presents a more powerful saber-tooth, but with no increased strength of the claws and limbs. Following this was a cat about the size of the red lynx, which had keen cutting edged canines, and strongly compressed. After this series of types the true cats appear in the middle Miocene of Europe and later in the upper Miocene of North America. By following foreign forms a gradual development is seen in the saber teeth, from that in the last false cat to that of the Pleistocene Saber-tooth tigers of Rancho La Brea. These foreign forms show a gradual lengthening, increased lateral compression, and, first one edge serrated, then both, until the final climax is reached in the very remarkable beast of our finds.



Skull of Saber-tooth Tiger.

The use of the sabers has been a standing puzzle and all manner of uses have been assigned them, from holding to the ice flows, to the climbing of trees. One suggests instruments of defense by a downward thrust, another as prehensile organs in capturing food and tearing the flesh into shreds, but the most probable use was that of stabbing its prey. These cats were not fish eaters and hence could not have developed these teeth in the way the walrus developed its tusks, and the remarkable claws present, would suffice for clinging; and, judging from its size, this animal likely lived upon the ground and sprang upon its victim from that position. It would seem as a means of defense since it was the largest of its kind, that such sabers were unnecessary, and also as its great claws would be formidable weapons against attack from wolves, coyotes, etc. It being in comparative peace with the lion, it had no fears from that source so long as there was plenty of vegetable eaters about, and the herbivores would of course give no trouble. It would therefore seem that there was no occasion to bring these teeth into play as means of defense.

These would appear clumsy indeed in ordinary chewing, or tearing of food and it has been urged that it could not have opened its mouth wide enough to admit a large piece of flesh.

A careful study of the anatomy of the skull of this animal, made first by Dr. W. D. Matthews of the American Museum, concluded that these teeth were used as stabbing organs, and this view is readily suggested by every skull in the collections made. The coronoid process is so small as to be almost wanting, which fact in connection with a shallow glenoid fossa, gives great freedom of motion to the mandibles. This freedom of motion may have allowed the lower jaw to drop down and back against the neck, while the sabers were being used for stabbing in the powerful downward stroke of the head. Figure 5. Judging from the spaces about the skull for muscles and muscular attachment, this animal must have had a powerful neck and could have sunk the sabers to their full depth of six inches into the flesh of any animal. With these considerations it is not difficult to see how a capture of prey might have been made. With a single leap this tiger could be upon the back of the largest mastodon, and, holding on securely by the great claws, could sink the sabers, and with a backward rip cause a long gaping wound which would supply a copious flow of blood. Then closing the mouth, the blood could be drunk or lapped at will.

Surrounded with such great beasts as the mastodon, elephant, giant ground sloth, etc., such feasts could be common, to say nothing of the great amount of flesh thus made ready for other animals.

Little wonder then, that when one of these huge beasts sought a drink in the tar beds, and his feet became fastened in the sticky mass, that he was an easy prey for one of the fierce tigers. Among the methods of capture of the cat tribe, one especially is of interest here. It is the habit of animals to grab for the throat of its victim, and by tenaciously holding on, strangle its prey, but this hold could not be readily obtained by the saber-tooth, and though obtained, it would not be secure when attempting to use the sabers, hence another habit of leaping upon the back of its victim was employed.

The claws were greatly developed, even beyond that of the lion and these rendered his position very secure.

The above facts prove beyond doubt that this tiger was the king of beasts in its day, and was the terror and deadly foe of all in all places. Surely no other combination of structure for strength, specialization for deadly work, and development for dealing effective blows has ever been grouped in a single animal.

With one blow of its massive paw it could crush any ordinary foe; with a single leap it could be upon the back of the largest beast, or away from its fleetest assailant; in the struggle for mastery over food it could hold at bay any intruder, and drink at will of the hot blood, which flowed after a single stroke of its immense sabers.

Even in view of these facts it must not be taken for granted that these tigers held their proud supremacy without challenge, for the proof is quite to the contrary. neither was war waged only between the tigers and other animals. It was among themselves that the last battles were fought and the last duel finished, with death both to the victor and the vanquished.

In these beds are found a number of skulls having either one or both tusks broken away completely, or in part, and the stubs show signs of much wear. In one instance the jaws of one tiger were firmly fixed in the mouth of another, with the teeth broken at the point of contact, as though both clung to the last, even in the throes

of death. As the bones of various animals are completely mingled in the pit, this case might appear to be one of accident but for the fact that the jaws were so tightly locked and the teeth badly broken at place of contact, it seemed that nothing but a sharp conflict between the two tigers could have caused such a condition.

Many teeth are found much worn down, some broken, in fact, imperfect teeth, are the rule rather than the exception. Injuries came to the animals in those days, as well as now. This is shown by the great scar in one excavated tiger skull. This scar is about four inches long and must have been made when the tiger was comparatively young. Since the wound caused an arrested development of that side of the head, as is seen by the very much smaller canine on that side. These imperfections are further noted in the failure of development of the molar teeth in the lower jaw of an otherwise fine wolf skull, in which the molar teeth are wanting.

Disease also and malformation occur, as in the case of Exostosis in the metacarpal of the lion, Figure 7, in which not only was the

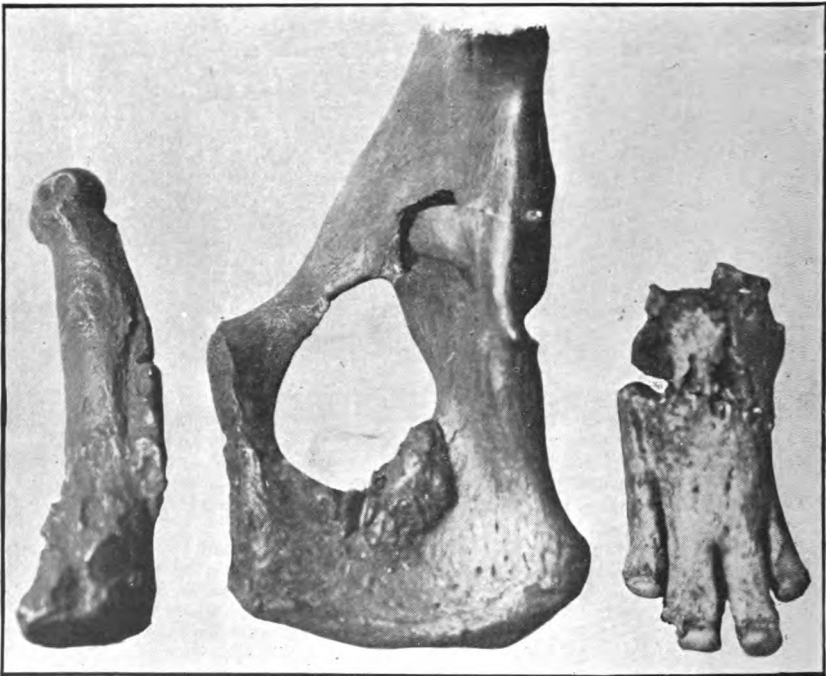


Figure 7.
Exostosis of Lion, Saber-tooth Tiger, Giant Wolf.

bone diseased but also a decided enlargement occurred in the body's effort to shut up, or heal the wound. The fusing of the bones of the lion's foot and an enlargement of pelvis occurred.

There are several causes for the extinction of animals, among which the most common are the lack of adjustment to environment

in way of food supply, ability for protection from enemies, over specialization, freedom from accident and the vitality of the race.

The factors which extend into the extinction of this species were most probably that of food supply, over specialization and accident. That the food supply became scanty is evidenced by the total extinction of the large animals upon which this species undoubtedly fed.

The saber-tooths were especially well fitted for obtaining food of a certain kind, but when this kind, the large animals, passed away they, too, disappeared. Therefore since the tigers were unable to reduce the size of the sabers to that required for effective feeding upon smaller animals, these teeth became poor instruments and when broken were worse than useless, a positive hindrance. Hence that which proved so effective under favorable conditions of a well-balanced fauna, became under unfavorable circumstances the very agent of its own destruction. Primarily therefore, over specialization was the cause of extinction.

The great American lion, *Felis atrox bebbi*, is one of the



Skull of a Lion.

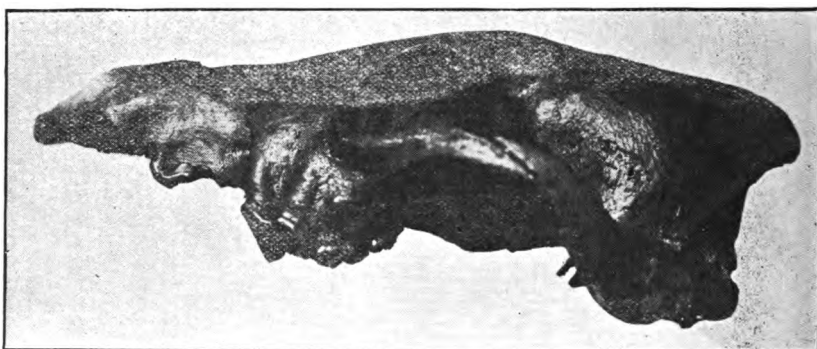
rarest finds of the whole deposit, and from the individuals found, the tigers out-numbered it ten to one. The scarcity of these animals is further evidenced by the fact that outside of these deposits only fragments of skeletons have been known. Of these fragments a large jaw found, in 1836, near Natchez, Mississippi, seems to be the best representative. To date only five good skulls have been reported. The first discovered in October 1908, by the writer, the second by Dr. Bebb of Los Angeles, December 1908, and the third by Walter Price Gilbert in July 1909, the others later by the Occidental College. These skulls indicate the African type of lion in their close resemblance to that animal, but are much larger than those of any other member of the whole cat family, either recent or fossil. So far as the writer has been able to ascertain, all specimens were obtained in the lower levels of the diggings, thus indicating an earlier extinction than that of the tigers.

The fossil fragments in the beds near Natchez and this rich find at Rancho La Brea, lead us to believe that this type of lion had a very wide geographical range in our country during the Pleistocene period. The association of the great American lion and the saber-

tooth tiger in the same horizon is a surprising fact. In some respects they are much alike, yet in others radically different. They represent two quite distinct branches of the cat family, which as noted above, have come up through many, many geologic ages, having their origin in the Orient and having roamed to North America in a more recent geological time. Having their birth place somewhere in southeastern Asia, they migrated to Africa, (where the allied species now survive) to the northwest where their remains are found, and to the northeast by way of the Behring region to our country where they became extinct.

These lions and tigers differed from each other in their race vitality. The tigers abounded in great numbers and would have survived to the present, but for the specialization of their canines and the scarcity of food. It is likely, however that the tiger out-lived the lion. Both became extinct in the new world approximately at the same time, but in the Orient conditions were more nearly like the original, and there the saber-tooth perished while the lions lived on and their offsprings are spread widely over the earth today.

Of the smaller animals, rabbits, rats, squirrels, badgers, gophers, coyotes and foxes are represented. These smaller forms are doubtless ancestors of our present forms, except the coyote which belonged to an extinct species.



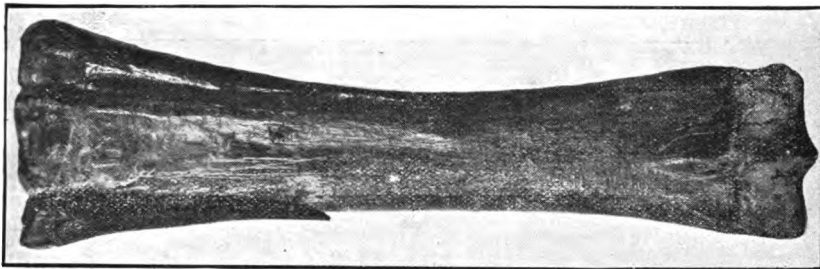
Skull of extinct Coyote.

It is but natural that these smaller animals should survive since they would not require the great amount of food as would the larger ones, and they could easily hide away and make their own retreat.

Most of these animals are supposed to have originated in the north. Though the United States is regarded as the home of the skunks and badgers. The skunks, though now spread over northern North America, and south and west over the United States, Central America and Guatemala, are regarded as originating in the Sonoran region, and in their migration came to California, and some left their record in the Brea Beds. The American badgers range well into the north, but are regarded as Sonoran in origin. Thus these two came west and leaving some remains in Rancho La Brea, survived with the country, and are now digging holes in the banks of the very pits in which their fated ancestors died.

The chief herbivores represented in the Brea Beds are the deer, antelope, American ox, camel, American horse, giant ground sloth, elephant and mastodon.

That such a large group of gigantic animals should be found to have roamed over our country is very remarkable, and at first was greatly doubted, yet the evidences are unmistakable, for their remains are actually secured from the tarry graves and the identity cannot be denied.



Splint bones of extinct Giant Horse.

Among the many species found, the ancient horse has contributed its share to the general subject of wonders. The specimens are fragments of horse both young and old, taken from the beds at a depth ranging from five to twenty feet. The greater number of individuals is either young or old, which is due to the inexperience of the young and the inability of the old. The specimens of dentition are either so immature, or are so worn with age that a satisfactory identification has thus far been quite difficult and doubtful. The material thus far obtained being quite fragmentary, specific identification has not been attempted. This scarcity of middle-aged forms is in harmony with reports from farmers in other parts of California, where the stock is caught in the local springs. The ranchmen report only young colts and very feeble animals among those caught. The young are easily frightened, and it is easy to understand how the sudden appearance of a saber-tooth in the midst of a herd would cause a stampede, which would likely result in one or more of these rushing into the pools of tar. This done, the result of one more fossil was inevitable.

While the horses found in our beds were the single-toed ones, yet they are not to be considered in any way related to the living horses, or those found running wild over the plains of Texas and the pampas of South America. These were doubtless of Spanish introduction.

Our fossil forms were the last remnant of that very remarkable race of horses found first in the United States. The real ancestor of the horses found in the London clays of Europe was an animal about the size of a fox. Very shortly after, this find was duplicated in the discovery of the same form in the Eocene Beds of the United States. These animals had four toes in front and three behind, while a still earlier ancestor called *Phanacodus* had in each foot five toes. It was from this little animal of the Tertiaries, that through the subsequent ages longer and longer bones having fewer and fewer toes appeared. Thus from age to age, the horse developed in size and lost in toes until we see the very singular animal of the fossil in the Brea Beds, a large, strong, but single-toed animal walking upon the end of the toe nail of the middle digit. America seems to be the original home of the horse, although the find is duplicated

in Europe in as early a horizon as here. If our correlations of horizons is correct, several problems are suggested, among which, whether Europe and America were once a common land area, or did the horse have a dual origin and thus gave rise to these similar forms, or after all was there only one place of origin, and migration took place at a date yet unknown? If only one, then which,—the United States or Europe,—is to be regarded as the home?



Figure 8.

Among the large forms that attract the visitors at the Brea Beds is that of an immense ox, *Bos antiquus*. The family to which this species belongs is the Bovidae characterized by hollow horns, hence what we find fossil are only the horn cores. Of the five specimens found, one is particularly large and likely a mature male, Figure 8, while the others are younger females, Figure 9b. The ox



a.

Figure 9.

b.

differs from the cow in its more convex and broader forehead, in the great size of the horn cores, which suddenly drop below the level of the occiput, and in the proportionately smaller teeth. The one figured in situ, Figure 9b, is the first find of the Academy. It is doubtless the skull of a female and measures thirty-one inches between the horn core tips. Enough material has been found to restore this skeleton entire. They are not represented in large numbers, and yet in comparing the size and habits of the species with that of others there must have been a great many in the country. The distribution of the American ox was wide over the whole northern hemisphere. The bison, which forms a distinct group of the genus *Bos* is characteristic of North America, although the *Bos Americanus* (living) ranges far down into the United States. The European bison in addition to spreading all over Europe in Pleistocene times, wandered to Arctic America. This group wandered still farther and one species was found in the Pleistocene of Texas in 1846. It was likely the progenitor of the recent species of this country. Peculiarly, this last has a very near relative in the Pliocene formation of the Siwalik Hills of India. It is further remarkable that none of these forms are found as yet determined in the Brea Beds, but another old World form, the ancient ox (*B. antiquus*), is our find.

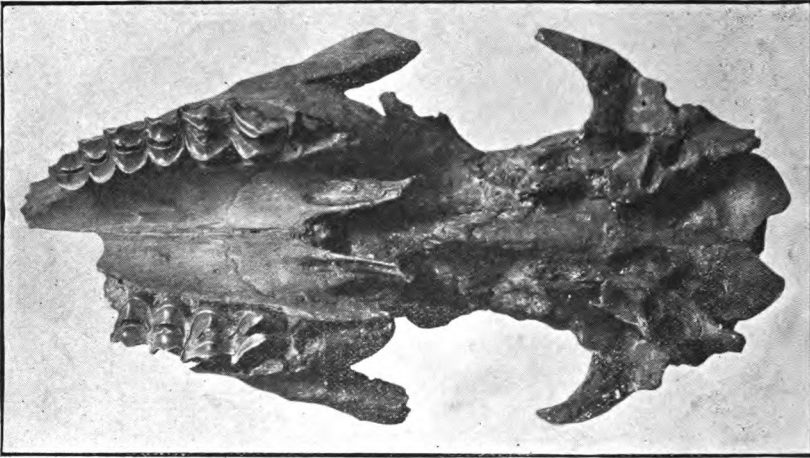
This species was no doubt, quite numerous, and attained to an enormous size, much larger than any living forms. A generalized type of the antelope (called *Protragoceros*) marks the first appearance of the hollow horned ruminants (*Bovidae*) which now affords numerous illustrations in the fauna of the old world. Thus another species flourished from the Miocene of Europe and India, spread over Asia, crossed the Behring bridge and then passed away, while the more hardy bison of our plains have survived.

To find camel material in our diggings was a happy surprise. Other large animals had been represented in fair numbers and to add the ancient camel to the long list was a pleasure, indeed.

Of this animal only an imperfect skull and several limb bones have so far been unearthed. For the living forms, (although none are now wild) our minds revert to the Orient and it is scarcely believable that they once strode over this country, yet this is true, as is evidenced by this and other finds which have been made heretofore, at other places.

Of the camel (*Camelidae*) family we have living representatives in the camels of Asia and Africa and the Vicuñas guanacos and llamas of South America. Fossil camels occur in the Pliocene of India and the Pleistocene of Algeria, while a host of extinct genera more or less closely allied to the living South America forms, occurs in the Tertiary deposits of the United States.

It is interesting to note that, since in Argentine and Brazil, remains of the llama and the related types occur only in the more recent of Monte Hermosa and Pampean and cavern deposits; these South America species evidently were comparatively recent immigrants to that region from North America. The fact, too, that the fossil remains are found no lower in India and Europe than the Pliocene, makes it certain that they migrated from Asia to the west into Algeria, appearing there in time to be fossilized in the Pleistocene beds. While the fossil remains are so scarce and so narrowly confined in the old world, it is quite the reverse in the new. In North America, camel remains range from the Pleistocene down to the lower Oligocene and with a geographical distribution that is as wide as the continent. From the living form downward we meet with such types as *Plauchenia*, *Procamelus*, *Protolabis* to the very small generalized animal of the



Skull of young Camel.

middle Oligocene called *Proebrotherium*, which in turn was preceded in the lower or Unita Oligocene by a representative called *Leptotragulus*, which itself may have sprung from a still earlier form, the *Homacodon* of the Bridger (earlier Eocene) beds.

It is quite evident that the camels of today came in rather direct line from more generalized forms and were originally a North American group. Hence when the camel lay down and died in the Brea Beds, it was buried in its native country. From this favored spot the earliest forms began their long process of differentiation and migration of the earth. That the molar dentition of the Siwalik camels is very similar to that of the vicunas and guanacos of South America is remarkable, and a common branch must appear somewhere in the genetic tree. Why this species (having peculiar molar teeth) should become extinct in India, but develop and survive in South America, is likewise a problem. What native tendency or habit or climatic conditions or character of food should, in two such widely separated regions, give rise to the dentition, and in the one fade away, and in the other survive, are queries that remain unanswered. In fact, the disappearance of the camels from North America is very strange indeed, yet not more singular and perplexing than the disappearance of this whole great group of other large animals represented in the Brea Beds.

On the whole then, we have here a very remarkable illustration of world-wide migration, beginning in the United States in the lower Eocene (Uintocene Oligocene) beds. From here the distribution was rapid over the Mississippi valley with one branch, (llamas) turning southward, and probably by the way of the Isthmus of Panama, entered the South American continent in the Post-pleistocene times, to be spread over the whole region and subsequently to survive in the sheltering Andes. The other branch (*Camelus*) pushed to the

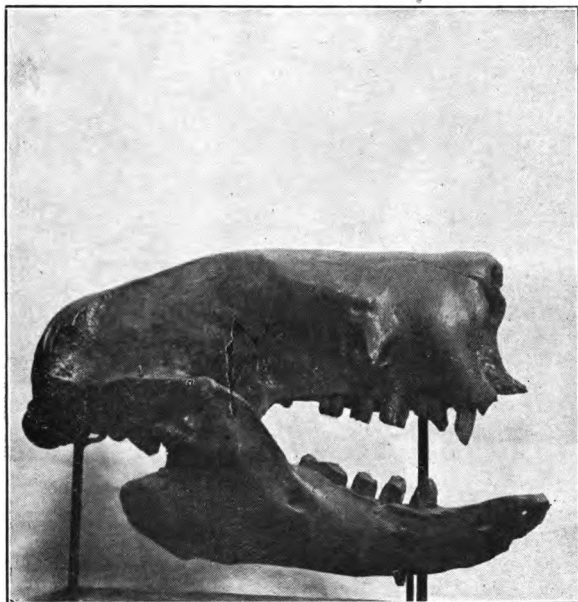


Figure 10.

northward during the time of a more seasonable climate than now exists, crossed Behring Strait into the old world in the Pliocene times: Thence the march was southward into India, westward into Algeria and gave rise, with modifications to the present camels of those regions.

Among the curious animals found in the fossil gardens of Brea Rancho, none are more odd and at the same time more plentiful, than the giant ground sloth. This animal is now nowhere known and only very distant relatives are found in the tree sloths, anteaters and armadillos of South America. The number of individuals represented in the beds is quite great. The skulls and limb-bones are met with more often than those of any other large herbivorous animals. Sufficient have been found to build a complete skeleton. The skull, Figure 10, is a very perfect specimen and a very large one. It was a well-matured animal as shown by the teeth which were badly worn. One other is less robust, but is an inch larger. The skull of a baby sloth, found next its mother, is shown in Figure 11. The humerus is of a mature individual, and presents very remarkable developments of prominences and concavities for muscular attachment, which indicate, in connection with the strength of the bone, a very heavy, strong-built animal.

The femur shows less irregularity, as is generally the case, but is very much stouter than the humerus. This, in connection with the immense pelvis, Figure 12, which measures 42 inches from ilium to ilium, and the other hindleg bones, proves the animal to have been built somewhat after the fashion of a kangaroo, (although in no way related to it) having a light pectoral girdle and limbs, and a

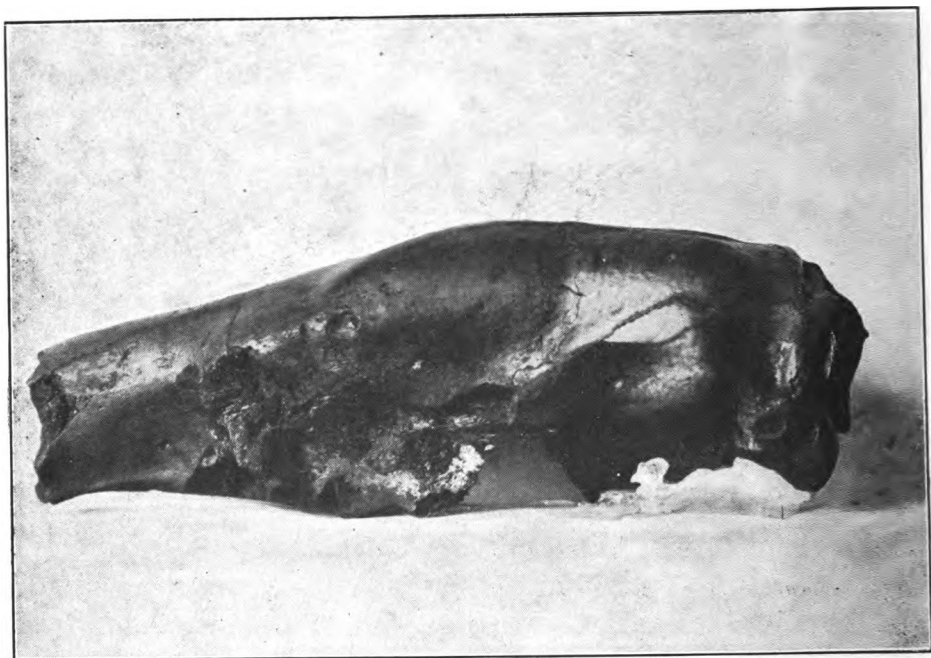


Figure 11.

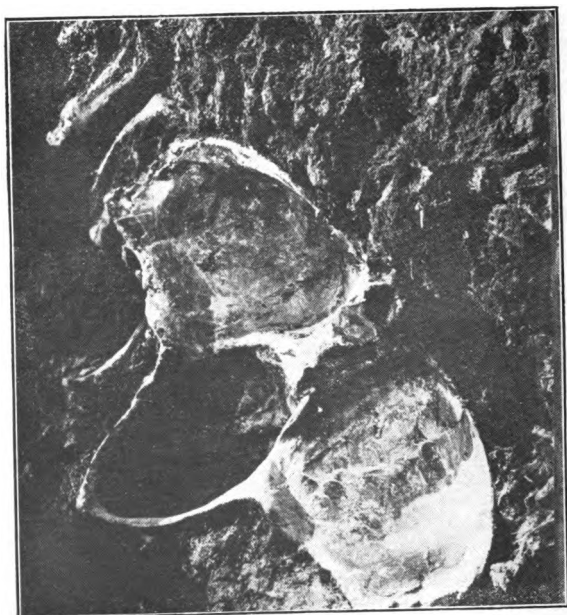


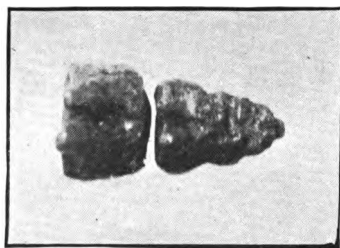
Figure 12.

very heavy pelvic girdle and limbs. In addition to this there was a very stout tail, sufficiently strong to form with the hind legs, a tripod upon which to stand while reaching into the trees for leaves and tender twigs. Judging from the skeleton, this animal must have measured as much as 22 or 25 feet from tip to tip. Its weight was perhaps that of a large ox. The strong peg-like teeth are set some distance from each other in the jaws. These occur only as cheek teeth there being no incisors. The absence of these gives them the name Edentates, meaning without teeth.

The last joint of each toe is tipped with a very sharp, curved claw instead of a hoof, as was suspected, judging from the flat teeth. The claws in front were doubtless used for reaching into the trees for food, and for digging roots. In this way the animal was so amply able to defend itself as to render a successful attack from an enemy almost impossible. Especially was this true since the pebble-like bones (called scutes) imbedded in the skin made it almost impenetrable. Little was known about the character of the sloth skin until ten or twelve years ago, when a well preserved piece of dried skin was found, having on the outside a growth of coarse hair and pebble-like bones imbedded within the skin. The discovery, made by Dr. F. P. Moreno of Chili-Argentine Boundary Commission, at Last Hope Inlet, in Patagonia, solved the mystery, and led to the search of a cave near by, where were found other remains, which pointed undoubtedly to the ground sloth as the real possessor of the skin. Dr. A. Smith Woodward of the British Museum, after a careful study of this piece of skin, showed that it had come from the ground sloth. It is interesting to note that this peculiar beast of our beds was covered with scanty coarse hair, resembling on the one hand the living tree sloth of South America, and on the other hand, by the dermal, pebble-like bones (scutes), the bony armor of the armadillos of the same region.



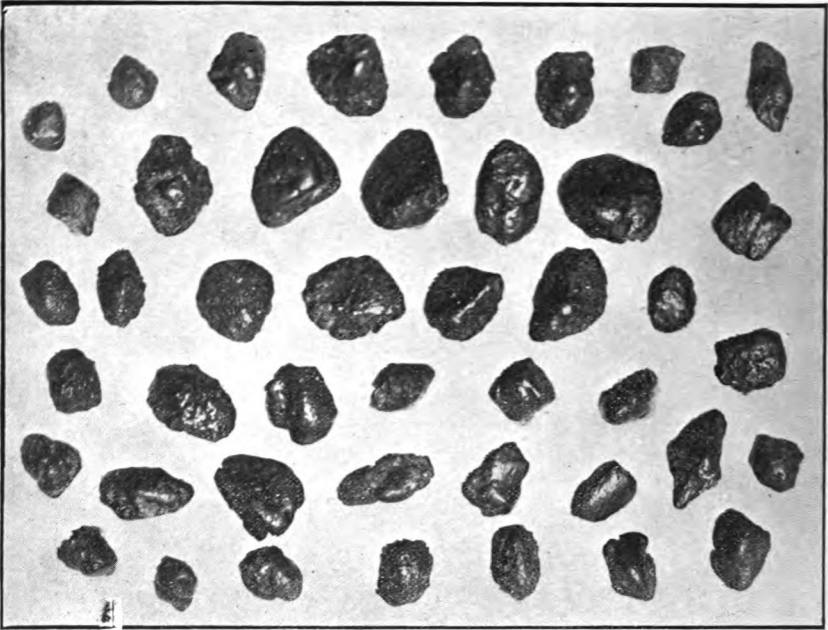
Skin of Giant Ground Sloth.



Caudal vertebrae of Giant Ground Sloth.

How this skin, discovered in Patagonia, was so well preserved through the thousands of years is yet unknown. Many pounds of these scutes have been found in the Brea beds, and Dr. J. C. Merriam reports a very interesting find of a section of asphalt containing a shoulder blade of the ground sloth with a layer of pebble bones over it. This fine illustration of the remarkable armor is on exhibition in the Museum at Berkeley.

While excavating, the writer found on several occasions several patches four or five inches square covered with these scutes. One piece was of much larger size. Some of the scutes were very close together, others were almost an inch apart. Being related to the living armadillos and sloths, our fossil form must have had some ancestors



Dermal Scutes of the Giant Sloth.

which would show the connection. In this we are not disappointed, for in examining the fossils of South America. there was found a very large strange animal, protected by a skin development of an almost complete bony armor, which formed a solid coat of mail. This differed from that of the armadillos in that the carapace of the latter was not a solid shield, but the bucklers in front and behind were connected by a number of movable, overlapping bands, which in some cases admitted the rolling of the animal up into a ball. But this giant Glyptodont, as it is called, walked around carrying its immense armor very much after the fashion of a great tortoise. This shield must have been very heavy, and doubtless had something to do with causing this animal to have very stout limbs. In other species this armor was beautifully ornamented, and all was surmounted by a heavy horny covering. The next animal had the armor made of plates arranged in rows separated from each other upon the sides of the body and the tail, had isolated bony tissues filled in between with smaller scutes. Strange enough it is that another fossil should be found in South America, a relative of the armadillos, which had plates, the outer surface of which was smooth, each being perforated with three or four large holes for the passage of blood vessels; which fact would indicate that the whole was invested with a continuous leathery skin. Thus the bony plates would be buried beneath the skin, or within it, just as in our giant ground sloth. One more species was found, one of this kind, a very little creature only two feet long, which had incipient movable bands in the margins of the middle region of the carapace, which remarkable fact

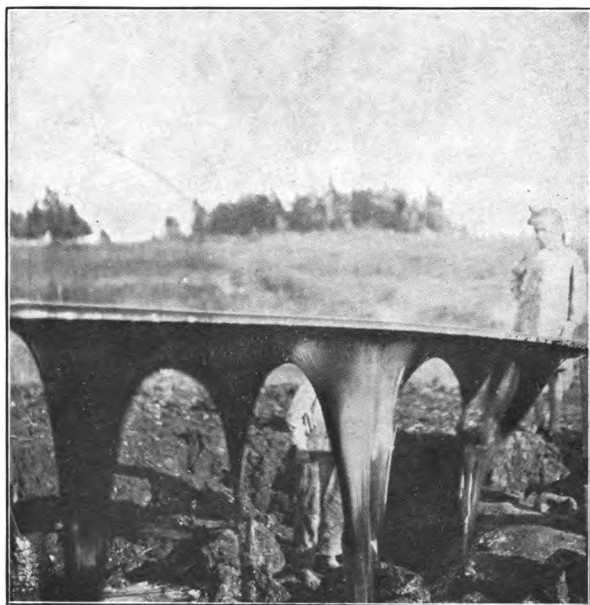
marks this small form as the common ancestor of the living armadillos and the armored glyptodonts, and in the size is found the resemblance to the ground sloths.

The giant ground sloth resembles living sloths in the shape of the skull and dentition, while in the limb bones they resemble the anteaters. The sloths of the Brea Beds therefore had their origin in the Santa Cruz beds of Argentine, from which place they spread over South America and wandered in Miocene times to North America, where they appear in the Pliocene and Pleistocene formations. They roamed as far north as Nebraska, east to Virginia, and west to the Brea Beds of California, and the caves along the coast. By the time they arrived here, they had grown to such enormous size as our specimens (*Morotierium*), and the armor had become reduced to mere scutes scattered here and there throughout the skin.

The only probable successful enemy of the sloth was doubtless the saber-tooth tiger, which would leap upon the back of this sluggish beast and with a stab and a rip backwards, would lay open the flesh and drink the copious flow of blood. Thus one by one, reduced by sudden death and longer starvation, the most peculiar of all our wanderers to the Brea Beds became extinct.

Where these came from to South America is not known, but if we regard the Pangolins and Aardvarks of the old world and the fossil specimens of doubtful affinity of France as related, then it is probable that our forms came from the Old World by way of an Antarctic continent.

It was in 1797 that our sagacious and philosophic President Thomas Jefferson found the first material, the claw bones of this sloth in a



Ribbons from an Asphaltum Spring.

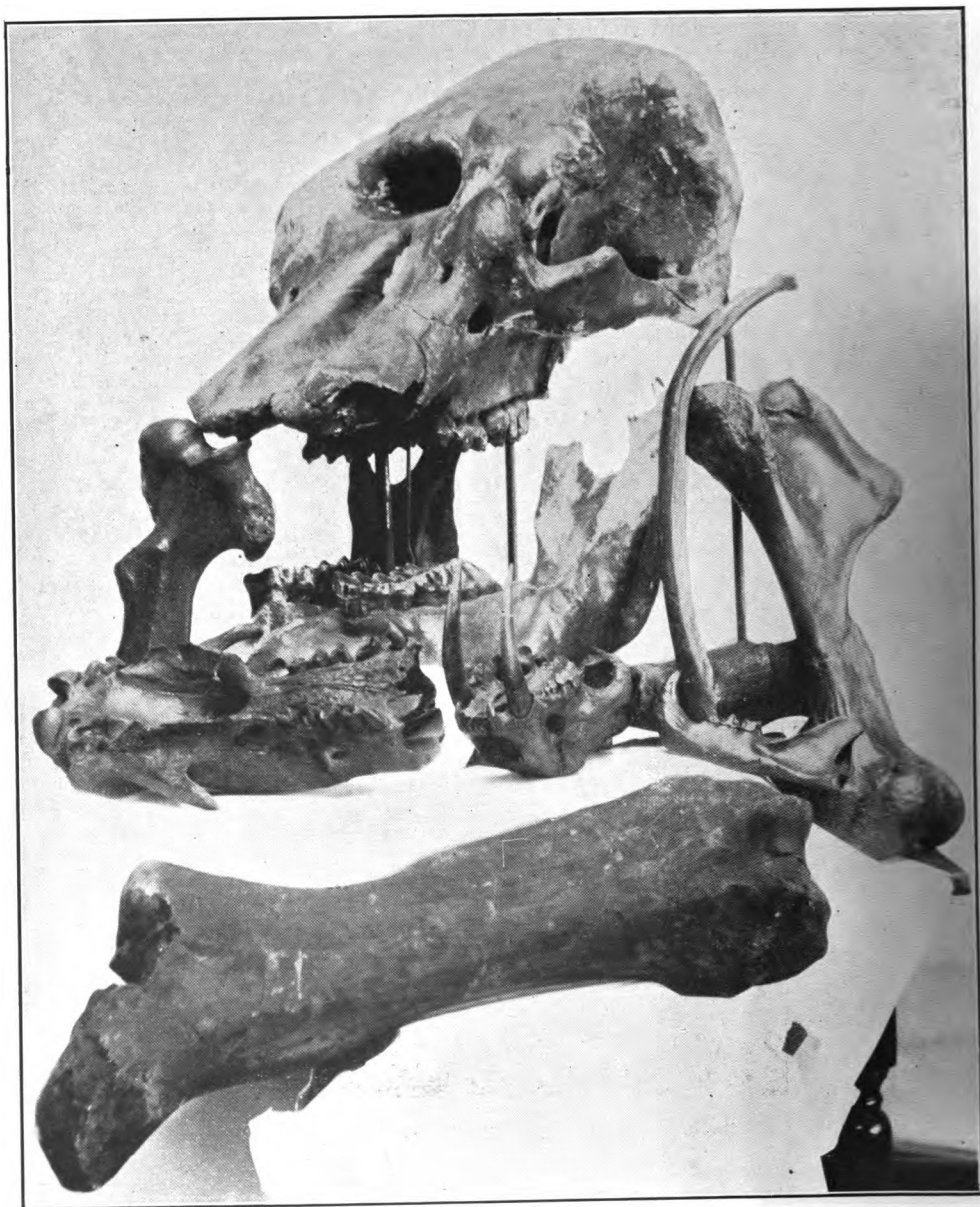


Figure 13.

cave in Virginia, and named it *Megalonys*, judging, since the animal had claws, that it was carnivorous. Later Dr. Harlan found some bones in the Big Bone Cave of Tennessee, and named them as a new species, but the true identity of the animal was not known until the remains were found in the caves of Patagonia. Here it was plain that the peg-like teeth of Tennessee and the claws of Virginia belonged to the same species. Thus was solved the mystery of carnivor-like claws, herbivor-like teeth and an armadillo-like skin all combined in one animal. So fresh seemed the material of the Patagonian caves, that an expedition was sent out to find, if possible, a living specimen, but as might have been expected, to no purpose. They had disappeared long, long before.

The mastodon is the largest fossil obtained on Rancho La Brea. It may be readily recognized by the cheek teeth, Figures 13, 14, in which the crowns rise in three to five low, transverse ridges separated



Figure 14.

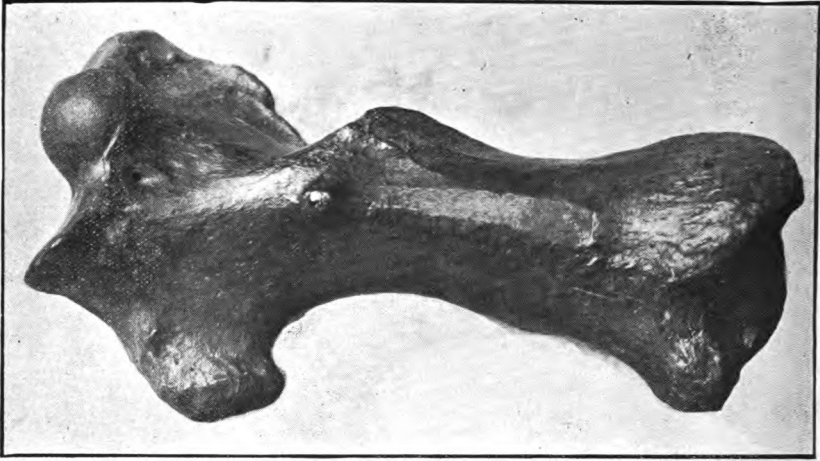


Figure 15.

into more or less distinct tubercles, with the tips merely pointed or irregularly cupped. Figure 15 shows the humerus of a Giant Ground Sloth, undoubtedly belonging to the beast whose skull is shown in Figure 10.

The specimens figured are of two individuals. The femur is from a mature and a larger animal, the remainder of which has not yet been found. The skull is of a young animal about two-thirds grown, however, so complete that every detail can be made out. The dentition is perfect, large and massive, and presents a beautiful, dark glossy luster. The tusks were represented only by short portions which were four inches in diameter, while the whole was probably four feet long.

During the excavation of these remains no little excitement prevailed about the place, as scores of wonderstruck and admiring visitors daily came to see the skull of the largest group of animal that ever stalked our valleys and drank at our springs. Good skulls are few in the United States, although fragmentary ones have been found in great numbers. These huge beasts which weighed more than our present elephants, were widely distributed over North America, appearing so far as known, in the greater numbers in the Mississippi Valley, being especially abundant in New York, Ohio and Kentucky. The earliest finds were made in New York, and were described as human bones of great giants. To identify such bones as being those of man, affords an illustration of the wild desire to find human remains associated with all animals.

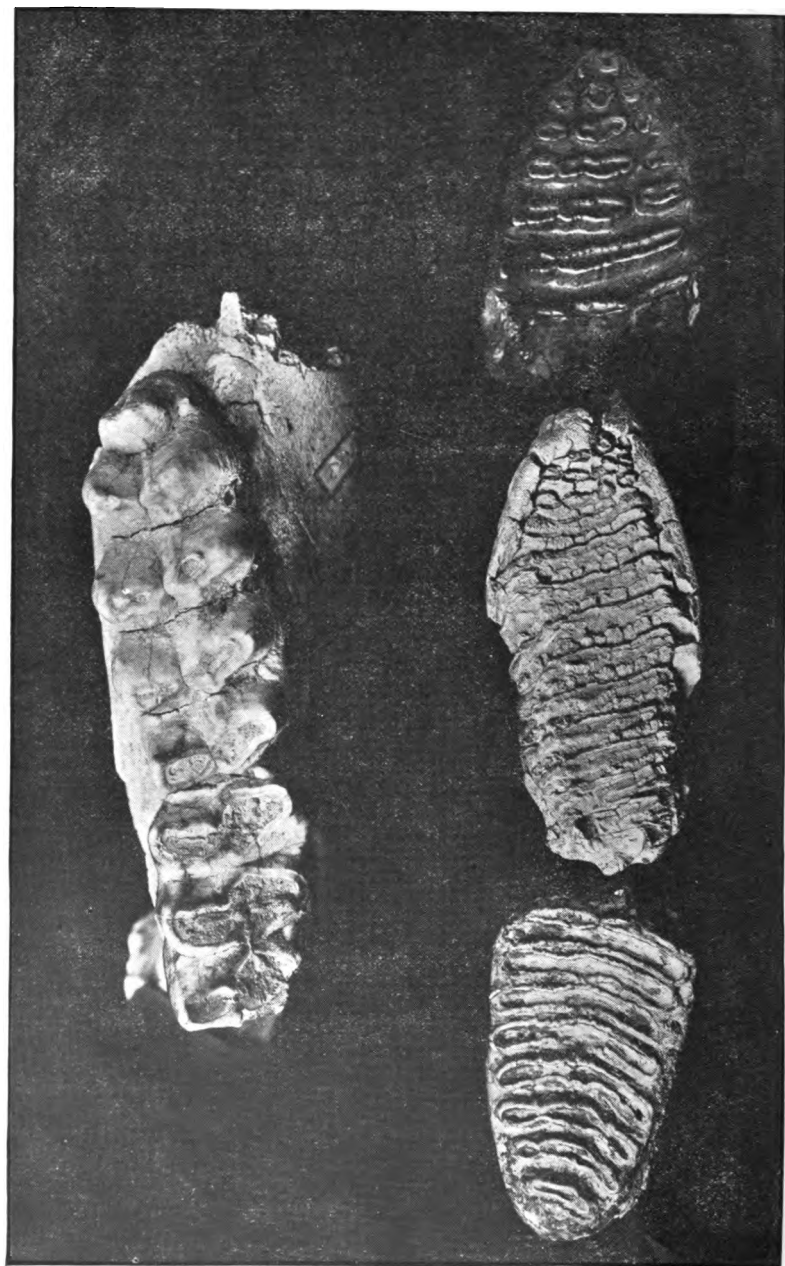
The elephant is represented in the beds by only a tooth and possibly by a few bones, enough however to prove their presence here. The other specimen of a tooth figured in connection with the dentition of the mastodon, was obtained by Mr. Homer Hamlin at Inglewood in the excavations of the outfall sewer, fifty feet below the surface. It is not through the direct relationship of this species, *Elephas Columbi* that the line of descent is traced, but through another species of North America, which is equivalent to *E. Primogenus* of Europe, which in turn is closely allied to the elephants of India

(*E. indicus*). Both of these doubtless originated from a common stock, from the Siwalik Hills of India, *E. hysudricus*. Since traces of the mammoth are also found, it is interesting to note the origin in southeastern Asia and to contemplate their migration to the north into Siberia, to the west into Europe, to the southwest into Africa and to the northeast along the Asiatic coast, across the Behring Channel, and thence in every direction over Africa. It is again interesting to learn that the living elephants of India and Africa have sprung from the mastodon of India, yet they were confined to India and only their nearly related progeny spread out over the world. The elephants commenced their more recent history in the Pliocene time in India and thence spread through northern Africa and Europe during Pleistocene times.

The elephants of India and Africa are the living representatives of the group of largest land forms known to history. This group is characterized by the presence of proboscis from which these ungulates are named Proboscidea. Of this group the family Elephantidea includes three genera, elephants, mastodons and mammoths. The elephants are readily recognized by their cheek teeth which have the form of more or less elevated parallel plates filled in between with cement. There is a species of elephant, a Pliocene fossil of Asia, which presents teeth with plates comparatively low, numerous and with little cement filling. This therefore stands as a connecting link between ancient mastodons and the elephants of today.

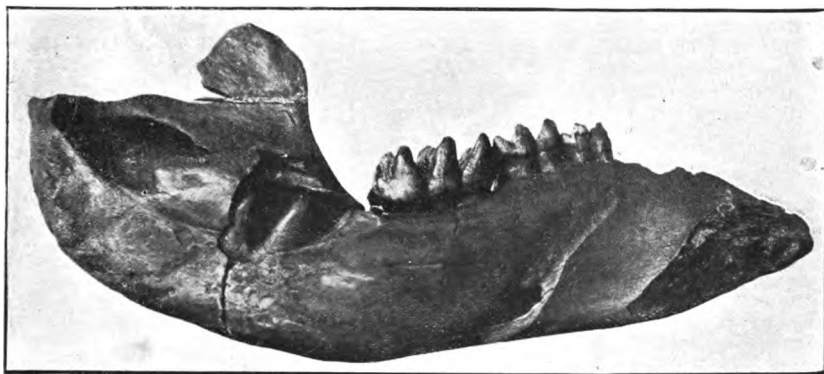
The elephant has forty-four teeth, eleven in each half of each jaw. While there are rarely more than this number, yet it is in cases greatly reduced—even to zero as in the ant-bears where the jaws are toothless. Since the individual grinders are greatly enlarged, and all others are lost save two grinders in each half jaw, and the second pair of incisors above, the number seems to be reduced to six in the elephant. The real number is greater than this. The tooth begins its growth in the rear of each jaw and gradually moves forward, (as shown by Sir Richard Owen) in the arc of a circle gradually replacing the preceding one as it wears away by use, until finally this older tooth is shoved from the jaw and the new one is in full service. Owen's dental formula for the modern elephant is given thus: Incisors, $\frac{2-2}{0-0}$ Molars, $\frac{6-6}{6-6}$ which means that there are two tusks in each upper jaw, the milk set being replaced by the permanent one, and the lower jaw wanting in these which in one of the fossil forms of mastodon are present. This formula further means that there are altogether six grinders in each jaw, the first milk teeth appearing at the age of two weeks and shed at two years.

The second is shed at six years, the third at nine, the fourth at twenty to twenty-five, the fifth at sixty and the sixth lasts the remainder of the creature's life, at least to the age of 100 or 120 years. With this data of Prof. Owen's in mind, it is intensely interesting to examine the dentitions of a young mastodon in which the full milk dentition of three well-formed cheek teeth is present, with the remarkable fact of the first permanent tooth just cutting the gums from below and behind the third milk grinders. Thus if the cutting of teeth of the modern elephant can be taken as fairly typical of the same process in mastodons, then the specimen is of a young mastodon, less than nine years of age. What a baby! A pathetic scene must have occurred here, for the remains of both the mother and the baby were found not over ten feet apart in the beds. The mother seemed farther on and in from the bank than



Molars of *Mastodon Americanus*, *Elphas columbi*, *Elphas primigenius*, *Elphas imperator*.

the baby. The mother may have ventured to drink at the tarry pool, or perhaps to eat of the scanty vegetation near it: But the treachery of the sticky subsoil proved to be a fatal trap, both for herself and her baby.



Right lower jaw of young mastodon, showing cutting of first permanent tooth.

The tusks of the elephant grow continually throughout life, hence do not become very hard and resistant, but soon decay. This fact accounts for the poor condition in which most of the tusks are found.

While the exact origin of the greath North American true elephant is quite perplexing, yet one thing seems evident, that they came from the Orient by way of Behring bridge. Three species occur here—*E. imperator* and *E. columbi* and *E. primogenus*. The first two of these roamed over the country together, from east to west, from north to south as far as Mexico. Only a single specimen tooth *E. imperator* having been reported from the lower Pleistocene of French Guiana. The evolutionary process of the Proboscidea began in Fayum, Egypt, with a form about three feet tall with only a slight protrusion of the upper lip for a proboscis and no upper tusks, but with the lower incisors extending forward. It is from the undeveloped and generalized form that the mastodons and elephants of Europe, Asia and America came. Thus began in Egypt one of the most remarkable race histories known to mankind and continued to the present and might persist as long as time shall last, but for the ravages of man.

From the foregoing it must be clear that, without exception, all the animals buried in the asphalt beds on Rancho La Brea were wanderers thither. Some from other parts of North America as their native home, while others had compassed the earth to arrive here. What a scattering of life in its instinct to roam: What an effort

to persist in the progeny of the races, and what a changed view of earth's fauna, is presented in the survey of the hidden treasures of these tar beds. The light thus far shed is pleasing and intensely interesting, yet as the more intense the light the deeper the darkness, so here the night of unsolved mysteries is only deepened. Whence, why and how these diverse forms, this enormous size, these varied degrees of activity, these original types, how these peculiar instincts, this rise of intelligence, this differentiation, the nicety of adaptation, the dwarfing and decay. What movements of earth, what changes of environment, what great catastrophe or relentless hand has caused this apparent extinction so sudden and complete.



Evolutionary changes of Proboscidea
Smithsonian Institution Report, 1908.

The student of geology sees in his mind a picture vastly different from the recent conditions and living fauna as he looks upon the strange forms of sloth, camel, ox, elephant, lion, tiger, etc. Nothing but a semi-tropical clime could have supported these gigantic animals, and their presence carries the mind across the water to Africa and India for duplicate life. Here the mastodon roamed from place to place, the American ox grazed on the plains, the giant sloth reached into the trees for the tender leaves and twigs, the stalking camels wended their way to the scanty watering places, the horse with its colt wandered peacefully among them. The hungry wolf, the giant tiger and the king of beasts, with their howl and snarl and roar

made hideous the night, while the sailing condor, the soaring eagle and the swooping hawk and birds of song made lively the air the livelong day. What happened to disturb this daily hum of animal life no tongue can tell, and only the vivid imagination of man can conjecture. The coast gradually rose to a higher level, the mountain spurs reached down to the sea and cut off the passage to the north and south, while the deserts of the east and the waters of the west prevented the escape. The drouth occasioned by the rise of the land and consequent decrease of water supply, resulted in scanty vegetation and scarcity of water. The large animals could not survive the drouth, hence one after another, year after year passed away. Many of these in their search for food and water found their grave in the tar pools and left their record there. The beasts of prey found each struggling victim a ready source for food, they themselves now and again, falling a helpless prey to those that followed. The great feathered tribe, not slow to see an opportunity, flew down and partook of a ready meal. These, too, striving here in their eagerness for food, would lose their balance, touch a foot, dip a wing, or drop a tail into the tarry mass, until they, in their turn became record-makers in the world's history.

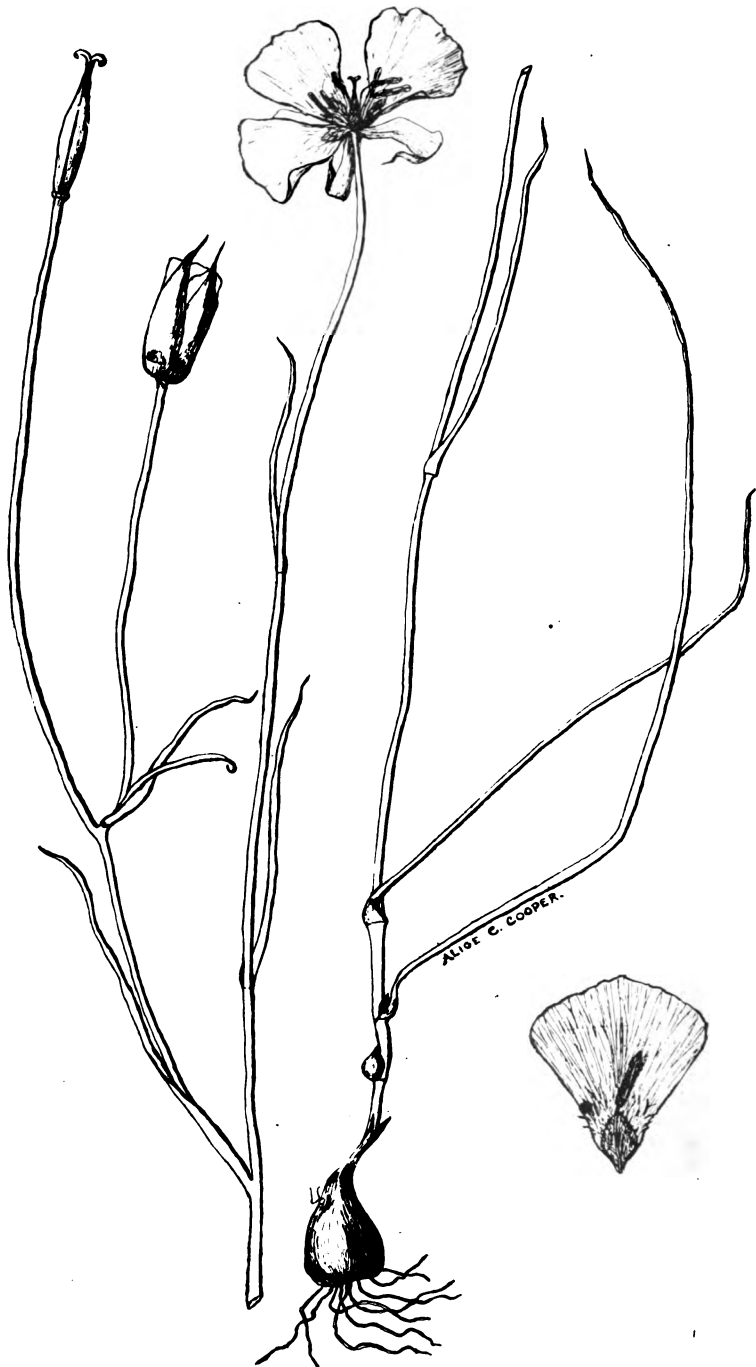
Nature, relentless and implacable, swerves not from her steadied course and yields no fixed law. Thus passed away a fauna as remarkable as it was abundant; and apparently as suddenly as a catastrophe and as completely as a total extinction.

The age to which the Brea deposits have been referred is early Quaternary, Pleistocene. The whole region has been a flood plain of deposition during which time the accumulation of fossils took place. Subsequently a gradual rise in the land occurred, resulting in making the region a plain of erosion, which it is today. This erosion uncovered the deposits to such an extent that the prehistoric bones are found from the surface down, as far as the digging has reached, (22 feet). No continuous record of fauna from the Pleistocene to the present has yet been found; on the other hand a sudden break occurs at the very surface and in the deposits yet covered with the layers of soil above and all specimens seem to belong to one group of a single time.

One interesting evidence lending support to the idea that this deposit is Pleistocene and that too probably the early (lower), is the presence of the Imperial elephant (*E. imperator*), which Prof. Richard S. Lull has said "appeared in the lower Pleistocene (*Equus* of Sheridan beds)". Although this tooth was found in the lower level of the diggings, yet other finds must be made and a better correlation of the Pleistocene deposits in general must be worked out before the exact location (lower, higher, or middle) in the Pleistocene can be determined.

Three of the specimens figured in this paper were not obtained by the writer. The elephant tooth, (*E. primogenus*) found on San Miguel Island, was loaned by Prof W. A. Fisk of Occidental College. The mastodon jaw (*M. Americanum*) and the elephant tooth (*E. columbi*) were found near Inglewood in the diggings of the outfall sewer, and were loaned by Mr. Homer Hamlin, Los Angeles. The back portion of a skull (*Teratornis californicus*) from the Brea beds was loaned by Prof. L. H. Miller of Los Angeles State Normal School.

My thanks are due to these gentlemen for their kindness.



Calochortus paludicola.—Davidson.

Calochortus paludicola n. sp.

Anstruther Davidson, M. D.

Corm membraneously coated; stem light green, slender, upright, bulbiferous at base, 4-6 dm. high; basal leaves 2 or 3, the lowest 1.5-2 dm. long, 4-5 mm. wide; folded; stem leaves 2-3 linear, 2.5-5 cm. long; flowers 2-4 never umbellate, 3.5-5 cm. wide, in full anthesis somewhat rotate, sepals oblong, lanceolate, acute, recurved 1.5 cm. long, one margin broadly scarious at base the other less so, internally yellowish with conspicuous oblong brown spots; petals rose colored to pale pink, obovate 2.5 cm. long, rounded above, occasionally prominent but never apiculate, claw purplish brown, triangular in outline 3 mm. wide by 5 mm. long, scattering yellow hairs on lower third of petals, filament and ovary light brown, anthers obtuse, white or pinkish, 5 mm. long slightly shorter than filament. Capsule 5 cm. long tapering at each end.

Meadows Bear Valley, San Bernardino Mts., 6500 ft. alt., July, 1909. No. 2171, Davidson-type.

Common in the semi-moist edges of the streams and meadows bordering the southern side of the Bear Valley dam. Heretofore it has passed as **C. invenustus**, but it has no relation to this but is more akin to **C. Palmeri**. Two other **Calochortii** are common in this range, viz., **C. invenustus** Greene, and **C. invenustus var. montanus** Parish. Of the latter Parish remarks, "it is not a satisfactory species and may be no more than a var. of **C. invenustus**."* Not a little of the confusion and uncertainty that characterizes much that has been written on the mariposas has arisen from the impossibility of preserving the peculiarities of the flowers in the dried state to that only the careful notes of the field student can ever determine their specific limitations.

To the author **C. invenustus** seems quite distinct from **C. splendens**. It somewhat resembles it in the narrow campanulate shape of the flower, but it differs in two important particulars. The sepals of a **splendens** are recurved or revolute and the inflorescence is never umbellate.

Parish has correctly transferred **C. splendens montanus** Purdy to **C. invenustus montanus** as it is obviously closely related to **invenustus**, rather than to **splendens**. I think it

*Bull. S. Cal. Acad. Vol. 1, 124.

would be more fitting to raise this variety to specific rank **C. montanus**. Mr. Parish says that *invenustus* is well connected by intermediates with *var. montanus*. In the mountains at Bear Valley these two are very distinct.

C. invenustus is abundant on the dry slopes among the live oaks and brush at Seven Oaks, at 5000 ft. alt. and was not seen at over 5500 ft. alt.

C. montanus is common on the dry slopes around Bear Valley dam at 6700 to 7000 ft. alt. The range of the two plants is here quite distinct with 2000 ft. alt. between and an examination of hundreds of them showed no intermediate forms.

On San Jacinto or other mountains it may show intermediates, as Parish says.

C. montanus lacks the green stripe on the exterior of the petals. These are darker sometimes deep purple colored with the claw yellow. If it possessed a light colored petal with a lighter colored claw than *invenustus* it might be considered a mere variation, but the darker petal with the lighter gland seems to negative this conclusion.

For the easier determination of herbaria specimens of the lilac colored non-oculate species, the following key may prove useful:

Flowers umbellate

Stems bulbiferous

Claw dark

Claw yellow

Stems not bulbiferous

Flowers not umbellate

Stems not bulbiferous and sepals not recurved. **C. Dunni.**

Stems bulbiferous and sepals recurved.

Flower cup shallow, gland triangular.

Flower cup deep.

Petals erose, gland small.

Petals not erose, gland indefinite.

C. invenustus.

C. montanus.

C. striatus.

C. paludicola.

C. splendens.

C. Palmeri.

Some Large Trees. I.

By Anstruther Davidson, M. D.

Our botanical papers and text books contain a full and accurate description of our native trees and their distribution in Southern California, but little has been written about their size or their actual measurement. Had actual measurements of our largest trees been recorded when they were first discovered, we would today have had very accurate estimate of the rate of growth and relative age of many of our forest giants. It is never too late to begin a good work and the following notes will, I hope, encourage others to search out, locate, and measure the large trees in their respective localities.

The Western Juniper (*J. occidentalis*) grows in scattered patches around Bear Valley dam in San Bernardino mountains. On a point on the south side of the lake about two miles from the Hotel there are a number of trees showing vigorous growth. Some of them are very large for what is described in our text books as a small tree. The tallest attain a height of 40 to 60 feet (estimated). The largest seen had a clean trunk for about 12 ft. and measured in circumference 5 ft. from the ground, 13 ft. 2 in.

A few other large ones have branched near the base so that at 5 ft. up, there were two trunks. The largest of these, a well foliaged tree about 50 ft. high, has the two trunks measuring 12 ft. 8 in., and 10 ft. 10 in., respectively. Another similarly forked, measures 8 ft. and 13 ft. 1 in. in circumference. The Bear Valley dam is already in process of being raised 12 feet higher. When that is accomplished some of the largest trees will be submerged. Of the other trees around Bear Valley the white firs (*Abies concolor*) and yellow pines (*Pinus ponderosa*) are the largest.

Of the firs there are some splendid specimens with tall massive boles towering 100 ft. in height. The firs favor the darker and more shaded canyons and meadow margins, and naturally attain their greatest size where moisture is most easily attained. The largest I saw grows on the edge of Bluff Lake meadow. It is 22 ft. in circumference 5 ft. from the ground. At the corral at Bear Valley meadow are two firs measuring 19 ft. and 16 ft. in circumference. Another large one 15 ft. 5 in. in circumference stands on the top of the grade between Seven Oaks and Bear Valley. None of the pines there attain the circumference of the firs. The largest yellow pine stands on the edge of the stream

at the Bear Valley store and measures 21 ft. 7 in. This pine has probably attained its full growth as the top is already dead. One at the garden fence at Seven Oaks is 16 ft. The largest one at Bluff Lake among the cottages is 13 ft. 10 in. in circumference. A sugar pine midway on the trail from Seven Oaks to Bear Valley, the largest seen, measured 18 ft. 1 in. and is one of the finest trees in the district.

Judging from some estimates made on some cut stumps of pines in the neighborhood of the hotel few, if any, attain an age of 300 years, the majority dying before 200 years. The rate of growth is so closely dependent on situation and moisture that mere size is no indication of age. Of the trees examined one showed 255 annual rings, yet was only 40 in. in diameter 3 ft. from the ground. The first 45 years it grew 18 in. in diameter. The next 40 it increased 8 in. The next 40 it increased 4 in.; while the last 4 in. of growth occupied 90 years.

From the estimate made of various stumps I concluded that in this district the average growth of the yellow pine was 1 inch in diameter every 5 years till it has attained a foot in diameter, after which the average is not more than 1 inch in 10 or 12 years.



Giant Sequoias.

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A typical Southern California semi-tropical scene.

Statement of Condition of
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At Close of Business, June 23, 1909

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Bonds, Securities, Etc.	-	-	-	-	2,508,930.00
Cash and Sight Exchange	-	-	-	-	5,169,501.49
Total-	-	-	-	-	<u>\$18,663,473.13</u>

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Circulating Notes Secured by U.S. Bonds	-	-	-	\$1,250,000.00	}
Less Amount on Hand and in Treasury for Redemption or in Transit	-	-	-	580,602.50	
Circulation	-	-	-	-	669,397.50
Deposits	-	-	-	-	15,064,779.33
Total	-	-	-	-	<u>18,663,473.13</u>

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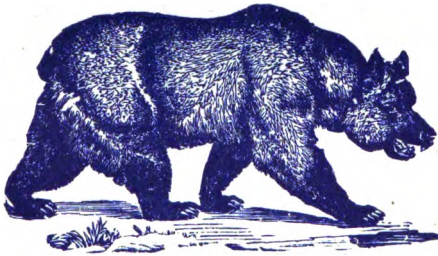
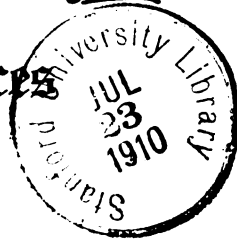
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2

BULLETIN

OF THE

Southern California Academy
of Sciences



LOS ANGELES, CALIFORNIA, U. S. A.

JULY, 1910



The Keese of the Academy Observatory
A last glimpse of Halley's Comet

BULLETIN
OF THE
Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.

Anstruther Davidson, C. M., M. D.

John D. Hooker

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Editorial

HALLEY'S comet visited us on schedule time and has departed on his seventy-five years' journey to outer space far beyond the orbit of Neptune, but, unlike the sheep of little Bo-Peep, he has left his tail behind him.

The astronomer of two or three generations hence, who will watch for his advent, will read, with wonder, the story of the lost tail, and perhaps the telescopes of that day may disclose a new, minute nucleus of a planet traversing this, the greatest orbit of our system in a vain pursuit to be reunited with its parent.

What has become of this enormous aggregation of millions of miles of attenuated gases? Are they of a meagerness so sapless, that they will be dissipated in space? Will they follow, in their present condition, through eternity, the path of the comet, or will they in time,—an immeasurable time,—by the attraction of gravitation, be consolidated into another Eros, and be captured by one of our larger bodies and chained to it as a new satellite, as perhaps was the fate of the three newly discovered outer moons of Jupiter?

It is an interesting subject for thought, not only by the astronomer, but by all who study the phenomena of our System.

A few years ago, the Academy was presented with an excellent telescope. It is a refractor, equatorially mounted, with an objective of five and one-half inches, and capable of a magnifying power of 100 diameters.

Mr. Keese, who is its custodian, adjoining his residence, has constructed a lecture room which is supplied with a powerful lantern and photographic appliances, and the location, on the hills of Shatto street, affords an unobstructed view of the heavens. Mr. Keese takes pleasure in throwing open the doors to these conveniences for the meetings of the various Sections of the Academy.

One of the most remarkable books of later days is the volume entitled "Modern Light on Immortality" by Henry Frank, Speaker for the Metropolitan Independent Church of New York City.

It is a work, as well for the Theologian whose edifice is founded upon faith, and the Scientific Materialist, who accepts nothing which cannot be proved by chemical analysis, as for the uncertain soul, troubled by the conflicting arguments for and against an alleged revealed religion.

The book is divided into two parts, the first giving a fair and candid history of the origin of the belief of an eternal, intelligent identity, after the disunion of our so-called material and spiritual parts, as taught by the Christian, the Jew, the Mohammedan and the faith of those millions of India which accepts neither a distinct hereafter-individuality nor an utter annihilation,—the Unity of a God, Emanation and Absorption and absolute happiness in Nirvana or absolute rest, of Vedaism or Buddhism.

The second part is devoted, in an equally candid way to the disclosures by modern science of the composition of the human body and its connection with the powers and functions of the soul, consciousness, or intelligence.

Those who have advocated the possibility of an endless physical existence on earth will find in this volume great satisfaction where he says, "When mankind shall have discovered the secret laws that appertain to the art of living, to Nature's own marvelous principles of life sustentation, we shall have overcome the mystery of death and shall continue to live and fructify in the no longer mortal bodies we occupy; or

That there shall be developed in some organism such a high degree of Self-Consciousness, that the physical seat in which this spiritual function resides and operates, shall be so controlled and integrated that it will be endowed with sufficient strength to continue its organic activities after this mortal coil shall have been shuffled off."

The student is left to draw his own conclusions, but there can be no doubt as to the settled ideas of Mr. Frank, when he writes as follows:

"Nowhere in the universe is there a space so minute as not to be occupied by material substance; and likewise, nowhere in the infinite is there an infinitesimal point of space or an instant of time, in which there does not inhere the principle of life.

Both matter and life being infinite, and two infinities being incapable of existing at the same time and place in mutual contradiction, matter must be a form of life, and life a form of matter." * * *

"I believe that Science will ultimately solve every problem that confronts the human mind and that to despair is to become absurd. So long as life is a phenomenon in Nature, it must be amenable to human research and its origin subject to the knowledge of man. If then, it should prove to be true that life after death is also a phenomenon in Nature, then that life, its character, evolution and history must also be amenable to human research and apprehension."

The work of cleaning and mounting the fossils from Rancho la Brea is proceeding with gratifying success, under the direction of Professor Gilbert. At this writing, a sabre-tooth tiger and a giant wolf stand in all the perfection of their skeleton ferocity, and bones of a giant ground sloth have been assembled, and work has been commenced on their mounting. A finely mounted and perfect skull of a sabre-tooth tiger, with sabres, eight inches in length, has been placed in the office of the Secretary where it can be seen at any time by members of the Academy and their friends.

Holdridge Geo Collins.



Additions and Corrections to the List of Southern California Butterflies.

By Fordyce Grinnell, Jr.

In the Bulletin of the Southern California Academy of Sciences, Vol. IV, No. 3, March 1905, Prof. J. J. Rivers gives a list of butterflies found within the area of Southern California, in which are enumerated 107 species. A number of the species have since been found to have been wrongly determined, partly due to the author of the present paper; since then a number of important books and papers have been published and more collecting done, so that it is time that a supplement to this list be published.

W. G. Wright's Butterflies of the West Coast, issued in October 1905, notwithstanding its many errors, idiosyncrasies, etc., added a lot of information on the Californian butterflies, prompted more work, and will become a classic. Grinnell & Grinnell, in the Journal of the New York Entomological Society, XV, 1, 37-49, 1907, published a paper on the butterflies of the San Bernardino Mountains, California. W. S. Wright in the same Journal published an Annotated List of the Diurnal Lepidoptera of San Diego County, California, based on collections during 1906-1907, XVI, 3, pages 153-167, 1908, a useful paper. Dr. Henry Skinner in Entomological News, XVIII, 9, 378, 1907, describes *Thecla loki*, n. sp. from San Diego County. And a few other short notes and papers. With the collections of Mr. V. L. Clemence, Mr. K. R. Coolidge, Mr. W. S. Wright and others, the butterflies are becoming better known, but there are still many vexing problems to solve, and with every addition to knowledge, more problems and complications arise.

In the following list I will give the additions and corrections to Prof. Rivers' list which occur to me, and hope it will be a spur to future work and more lists. Dr. Dyar's generic arrangement is adhered to as in the previous list, but in his A Review of the Hesperidae of the United States, of 1905, a number of generic names are changed. In the summer of 1908, the author spent three months in the San Jacinto and Santa Rosa Mountains, and a number of interesting points in distribution noted.

Papilio indra Reakirt. Should be stricken from the list. It is a Northern California species. **P. Pergamus** is its Southern representative.

Papilio coloro n. var. of Wright's Butterflies is a synonym of **Zolicaon**.

Papilio bairdii Edwards. Incorrectly named **asteroides** Reak. in Grinnell & Grinnell's List. San Bernardino Mts.

Papilio philenor Linn. Occasional at San Diego (W. S. Wright).

Synchlœ australis Grinnell. Described in the Canadian Entomologist, Feb., 1908. Millard, Arroyo Seco, Eaton and probably other cañons of the San Gabriel Range and San Bernardino Range (Wright). Hemet Pk. San Jacinto Mountains, 7065 feet, May, 1908 (Grinnell). **Creusa** of Rivers' List probably refers to this species; but **creusa** may be found in Southern California.

Synchlœ cethura morrisonii Edwards. Near San Bernardino (Wright).

Synchlœ deserti Wright. "Garnet Knob," "Caliente" (Wright). One was taken on Little Mountain near San Bernardino this last spring by Clemence. It is a form of **cethura**.

Synchlœ thoosa Scudder. Said by Wright to be the desert form of **reakirtii**. Taken in different desert localities by Wright.

Synchlœ flora Wright. San Gorgono Pass (Wright). Needs investigating further, as do many other butterflies.

Synchlœ mollis n. v. Wright, is an individual variation of **Sara** not worthy of a name.

Synchlœ pima Edwards. Taken above Yuma on the Arizona side of the river, but undoubtedly found on the Californian side.

Synchlœ caliente Wright. Colorado Desert (Wright).

Argynnis laura Edw. or **macaria** Edw. Common near Mt. Pinos, and Mt. Breckinridge, Kern County, in June 1904 and 1905.

Argynnis atossa Edwards. Tehachapi Mountains. One taken at Mt. Pinos in June, 1904, is typical **atossa**; is evidently a direct off-shoot of **laura** or **macaria**.

Lemonias quino Behr. Augusta Edw. is a synonym. San Diego, Riverside, San Bernardino, Keen Camp, etc.

Lemonias anicia Db.-Hew. San Bernardino Mountains, 6300-8500 feet elevation. Wrongly called **augusta** in Grinnell & Grinnell's List.

Thessalia leanira should be stricken from the list; **leanira** is the northern Californian form and **wrightii** the southern form.

Melitaea cerrita Wright. Is an aberration of **wrightii**.

Cinclidia chara Edwards. Colorado Desert. (Wright).

Chlosyne californica Wright. Colorado Desert (Wright), and San Diego County (W. S. Wright).

Polygonia chrysoptera Wright. Big Santa Anita Cañon, San Gabriel Mountains (Grinnell).

Basilarchia obsoleta Edwards. Imperial Valley. Yuma, common.

Cercyonis sthenele Boisdural. Should be stricken from the list. It was described from the San Francisco sand hills, but is supposed to be extinct. Dr. Behr had a good series in his collection (destroyed by the San Francisco fire) of this distinct species.

Cercyonis paulus Edwards. Common in the mountains.

Chrysobia mormo Felder. Colorado Desert (Wright).

Polystigma palmerii Edwards. Colorado Desert (Wright) and above Yuma (Clemence.)

Thecla nelsonii Boisdual. I took this commonly on Santa Rosa Mountain and in Strawberry Valley.

Thecla loki Skinner. Jacumba, San Diego County, W. S. Wright and Field.

Callicista ines Edwards. Desert side of Santa Rosa Mountains, Palm cañon; San Diego County, a beautiful butterfly.

Callicista columella Fab. Recorded by W. S. Wright from the city of San Diego.

Callicista avalona Wright. Santa Catalina Island, Wright and Clemence.

Incisalia eryphon Boisd. San Bernardino Mountains.

Callophrys affinis Edwards. Is undoubtedly the same as **dumetorum** Boisd.

Tharsalea hermes Edwards. San Diego.

Cupido fulla Edwards. Common on the higher parts of the San Gabriel, San Bernardino, San Jacinto and Santa Rosa Mountains. Variable and evidently beginning to form separate species.

Cupido lycea, **pheres** and **icarioides** should be stricken from the list.

Cupido daedalus Behr. San Bernardino Mountains and Tahquitz Valley, San Jacinto Mountains. Found in the Canadian life zone up to 8500 feet altitude. **Cupido hilda** of Grinnell and Grinnell's list is a synonym.

Nomiades antiacis, **behrii**, **orcus** and **mertila** should be stricken from the list.

Nomiades polyphemus Boisdual. The common spring Blue, found everywhere at the lower altitudes in Southern California. The butterflies figured in Bulletin, No. 1, Vol. VIII, of this Academy, belong to this species, instead of **antiacis**.

Phaedrotes sagittigera Felder. Found to be rather common in La Cañada to the Tujunga Valley, this last spring (April).

Rusticus emigdionis Grinnell—**melimona** Wright. San Emigdio Cañon, Kern County, and Waterman Cañon near San Bernardino.

Leptotes (?) **astragala** Wright. San Bernardino (Wright).

Copaodes candida Wright. The record of **procris** in Rivers' List should be this species.

Copaeodes wrightii Edward. Mojave Desert (Wright).
Copaeodes eunus Edwards. Sierra Nevadas of Southern California (Wright).

Eudamus proteus Linn. Found by Rivers in the bean fields near Santa Monica and in Santa Monica cañon, and in San Diego (Wright, W. S.). Called the Long Tailed Skipper. A note on this was published in the Los Angeles Times.

Thorybes mexicana Herr.-Sch. Occasional.

Erynnis californica Wright. Southern California mountains.

Anthomastor pratincola Boisd. Recorded by W. S. Wright from San Diego County.

Megathymus neumogenii Edwards. Recorded by W. S. Wright and W. G. Wright and said also to be found in the Tehachapi Mountains. A large skipper.

The **Hesperiidae** are yet in a very chaotic state, and need much study.



Acrolasia tridentata. n. sp.

By Dr. Anstruther Davidson.

Low annual, short-caulescent, 5-7 cm. high; leaves lanceolate ovate, coarsely toothed, 2-3 cm. long, tapering to a broad, short petiole, midrib well marked underneath; flower 15 mm. long, short peduncled, and devoid of bracts; sepals 6 mm. long, lanceolate acute; petals five, light yellow, 12 mm. long, lanceolate ovate; filaments all expanded in lower half into flat bands, 1 mm. wide, and 3 mm. long, terminating above in three short teeth, the central one bearing the remainder of the filament and anther; fruit unknown. Whole plant is rough with the retrorse prickles of the genus, the bases of the leaves, and base of the flower pilose.

This plant comes nearest **A. tricuspis** (Gray), but it is much smaller and more hoary, and has not the conspicuous pale bracts of that species. The peculiar dilatation of the basal part of the filament easily distinguishes it from others of the genus. Type 2460, Hasse & Davidson. Banks of Haiwee Reservoir, Inyo County, April 26, 1910.

Preliminary Report of Studies of Vertebrate Blood.

By Louisa Burns, M. S., D. O.

This series of studies was begun because of the lack of reports of studies in the comparative morphology of blood. The hope is, also, studies of the development of the blood corpuscles might throw some light upon the changes in human blood under certain pathological conditions.

The hemoglobin was determined by Dare's hemoglobino-meter. Normal human blood reads 100% by this instrument. The corpuscles were counted by the Thoma-Zeiss apparatus, with a counting chamber of Turck's ruling. The blood was diluted two hundred times with Toisson's fluid. The differential count was made from smears stained with eosinate of methylene blue. From five hundred to one thousand cells were counted by the differential method. The work was done in the laboratories of The Pacific College of Osteopathy, and the apparatus used was provided by that school.

The first count is that of the blood of an adult female dog. Hemoglobin, 100%,—i. e., equal to the hemoglobin of normal human blood. Erythrocytes, 6,984,000 per cubic millimeter. Each erythrocyte carries 74-100 as much hemoglobin as does each human erythrocyte. Leucocytes, 11,800 per cubic millimeter. Of these, 3.8% or 448 per cubic m. m. were large lymphocytes, resembling those of human blood. 35%, or 4130 per cubic m. m. were small lymphocytes, resembling those of normal human blood. These numbers exceed those of normal human blood.

Mononuclear neutrophiles were not found in numbers to equal 1-10 of 1%.

48%, or 5664 per cu. m. m. were polymorphonuclear neutrophiles. These were rather smaller than those found in human blood, and they are also less numerous.

10.8%, or 1274 per cu. m. m. are eosinophiles. The granules of these are larger than those of human eosinophiles, and the numbers are ten times as great as in normal human blood.

The basophiles (granular, polymorphonuclear) include 2.4%, or about 283 per cu. m. m. These resemble similar cells in normal human blood, but are about ten times as numerous. A very few amphophiles were found, less than 1-10 of 1%.

The blood serum is isotonic with human serum.

The Cat. Hemoglobin, 80%. Erythrocytes, 6,392,000 per cu. m. m. Erythrocytes smaller than human, as a rule, regular in shape, variable in size. Each erythrocyte carries 62-100 as much hemoglobin as human erythrocytes.

Leucocytes, 13,000 per cu. m. m. These stain more feebly than does human blood.

Large lymphocytes, 7%, or 910 per cu. m. m.

Small lymphocytes, 68.6%, or 8,918 per cu. m. m.

Mononuclear neutrophiles, .6%, or 78 per cu. m. m.

Polymorphonuclear neutrophiles, 20.6%, or 2,678 per cu. m. m.

Eosinophiles, 3.2%, or 416 per cu. m. m.

No basophiles were found.

Serum hypotonic to human serum.

Adult male guinea pig.

Hemoglobin, 110%.

Erythrocytes, 6,216,000 per cu. m. m. Smaller than human, but of the same form. Each erythrocyte carries 1.06 times as much hemoglobin as the human erythrocyte.

Leucocytes, 6,500 per cu. m. m.

Large lymphocytes, 2.4%, or 156 per cu. m. m.

Small lymphocytes, 35.6%, or 2,314 per cu. m. m.

Mononuclear neutrophiles, .2%, or 13 per cu. m. m.

Polymorphonuclear neutrophiles, 56.8%, or 3,692 per cu. m. m.

Eosinophiles, none found.

Basophiles, (polymorphonuclear, granular) .4%, or 26 per cu. m. m.

Amphophiles, 4.6%, or 299 per cu. m. m.

Many highly refractile granules are present. These may be singly placed, or they may appear in groups of various sizes. They do not stain in the eosinate solution.

The serum is isotonic with human blood serum.

Mouse, grown, young, male.

Hemoglobin, 80%.

Erythrocytes, 3,016,000 per cu. m. m. Erythrocytes smaller than human, irregular in size and form, though always saucer shaped and without nuclei. Each erythrocyte carries 1 2-3 times as much hemoglobin as the human erythrocyte.

Leucocytes, 9,300 per cu. m. m. Of these, 94%, or 8,742 per cu. m. m. are lymphocytes, resembling the large lymphocytes of human blood.

Small lymphocytes, 6%, or 55 per cu. m. m.

Neutrophiles and eosinophiles, absent.

Basophiles, very few, less than 1%.

Serum, hypotonic to human serum.

Adult hen.

Hemoglobin not found.

Erythrocytes, 1,992,000 per cu. m. m. The erythrocytes of the non-mammals are oval, bi-convex, nucleated cells.

Leucocytes, 64,700 per cu. m. m.

Large lymphocytes, 2.8%, or 1,812 per cu. m. m.

Small lymphocytes, 88.6%, or 57,424 per cu. m. m. The lymphocytes are much smaller than those found in human blood, and they stain very feebly.

Neutrophiles, none found.

Eosinophiles, 5.8%, or 3,763 per cu. m. m.

Basophiles, 2.5%, or 1,618 per cu. m. m.

Amphophiles, 3%, or 254 per cu. m. m.

The eosinophiles and basophiles resemble those of human blood.

Serum. isotonic with human serum.

Adult female toad.

Hemoglobin, 63%.

Erythrocytes, 526,000 per cu. m. m. The erythrocytes are oval and mostly nucleated, very irregular both in form and size. A few non-nucleated cells are seen.

Leucocytes, 27,800 per cu. m. m.

Large lymphocytes, 1%, or 278 per cu. m. m. These resemble the lymphocytes of medium size sometimes found in normal human blood.

Small lymphocytes, oval, rather deeply staining, 46.6%, or 17,058 per cu. m. m.

Small lymphocytes, round, feebly stained, 33.8%, or 9,396 per cu. m. m.

Mononuclear neutrophiles, 2%, or 556 per cu. m. m. These stain very feebly, nuclei often eccentric.

Polymorphonuclear neutrophiles, 9.2%, or 2,758 per cu. m. m. These stain very feebly, nuclei extremely irregular in form.

Eosinophiles, 1.6%, or 445 per cu. m. m. Stain very feebly. Granules irregular in size, often very large.

Basophiles, 5.8%, or 1,612 per cu. m. m. These stain with remarkable brilliancy, the granules are like those of human basophiles. They are usually mononuclear.

Serum, isotonic with human serum.

Adult goldfish.

Hemoglobin, 50%.

Erythrocytes, 935,000 per cu. m. m. Erythrocytes vary from oval to almost round, nucleated, each erythrocyte carrying nearly 27-100 as much hemoglobin as the human erythrocyte. A very few non-nucleated cells are found.

Leucocytes, 44,400 per cu. m. m.

Large lymphocytes, 3.2%, or 1,421 per cu. m. m.

Small lymphocytes, 62%, or 27,528 per cu. m. m. The lymphocytes vary greatly in their staining reactions.

Neutrophiles, 30%, or 13,320 per cu. m. m. These cells

are nearly oval varying to bluntly triangular, with small, feebly staining granules. They usually have a single nucleus, very eccentrically placed, often in contact with the periphery of the cell for more than half the circumference of the nucleus.

Eosinophiles, none found.

I. Basophiles, nuclei centrally placed, 2%, or 888 per cu. m. m.

II. Basophiles, nuclei eccentric and in contact with cell periphery, 2.8%, or 1,343 per cu. m. m.

Serum, hypotonic to human serum.

Further studies will be reported as the counting is completed.

Transactions of the Academy.

OCTOBER.

The first lecture of the season of 1909-1910 was given by Professor James Z. Gilbert on Monday evening, October 4, 1909, in Symphony Hall.

His subject was "The extinct fauna of the Southwest, as represented by numerous fossils of extinct animals discovered at La Brea Rancho."

A large attendance was in presence and a very pleasant episode of the evening was the music of the young ladies' Glee Club of the Los Angeles High School.

In introducing his subject, Prof. Gilbert paid a tribute of thanks to Mrs. Erskine M. Ross for her gracious allotment of a tract on her ranch, and the liberality of Mr. John D. Hooker and the Council of Los Angeles, which had enabled him to carry on the excavations without cessation throughout the entire summer.

Upon the screen he presented views of the small lake in the eucalyptus grove and explained the geological and paleontological conditions of the district surrounding this unique deposit of fossils.

The ancient spring of water, gushing through a bed of asphaltum, was a fatal trap to hold to their death the numerous animals of earth and air, which resorted to this place to quench their thirst.

A most interesting collection, in an excellent condition of preservation, of the fossils of the lion, the sabre-toothed tiger from infancy to old age, the wolf, mastodon, giant sloth, camel, horse, antelope, small rodents of numerous species, the peacock, the great condor, and the ancestors of the eagle, and many other animals whose descendants are now found only in tropical lands, was placed upon exhibition, and their characteristics explained by the Professor, and at the close of the address these remains were examined by the intensely interested audience.

At a meeting of the Directors in Symphony Hall on October 4, 1909, at 7:30 o'clock p. m., all were present except Dr. Bullard and Mr. Baumgardt.

It was resolved to organize a Musical or Harmony Section, and the matter was placed in the hands of Professor Watts, with power to act.

It was also decided to admit to membership boys of the Los Angeles High Schools, and to permit them to pay their dues by labor in the excavation work, under the charge of Professor Gilbert.

The Board adjourned to meet on Friday, October 8th, in the office of the Academy, at 4 o'clock p. m., to act upon other matters of importance which have been presented for consideration.

The Board of Directors held a meeting on Friday, October 8, 1909, at 4 o'clock p. m., in room 625, San Fernando Building.

Present: Messrs. Watts, Spalding, Davidson, Collins, Parsons and Whiting.

Professor James Z. Gilbert was in attendance upon invitation of the Directors.

A communication was presented from Mr. George La Mont Cole, of Pasadena, asking whether this Academy will consider a proposition from the Field Columbian Museum of Chicago, Ill., to join with us in the excavations at the Rancho La Brea, sharing with this Academy in the results.

The Secretary was instructed to inform Mr. Cole that any proposition of this character must come directly from the authorities of the Field Museum, who are empowered to act, and the terms and conditions under which the Field Museum may desire to join with us in the prosecution of said excavations must be stated clearly and in detail before this Board would consider the subject.

Professor James Z. Gilbert and Mr. William A. Spalding were unanimously elected Fellows of this Academy.

It was ordered that the dues of all persons elected to membership in this Academy during the last three months of the year shall be credited to them for the entire succeeding year, and that the dues of \$3.00 for one year shall be paid before the application for membership will be considered.

The Secretary was authorized to purchase a blank book for scraps and miscellaneous items of news relating to this Academy and its members.

A vote of thanks was given to the young ladies of the Glee Club of the Los Angeles High School, for the music rendered at the last meeting of the Academy.

The following gentlemen were elected to membership, viz.: Ralph C. Daniels, 813 North Avenue 65, City; A. L. Cavanagh, 1415 Fourth Avenue, City; M. S. Moore, 1035 West Thirtieth Street, City; H. W. Stanton, 760 Whittier Street, City; John V. Frederick, 2530 E. Third Street, City; and W. A. E. Noble, 1139 Forest Avenue, Hollywood.

Professor Gilbert presented a report of his receipts and expenses in the prosecution of the excavations on Rancho La Brea, which was approved and ordered to be recorded. Said report is as follows, to-wit:

"FINANCIAL STATEMENT OF FUNDS OF THE SOUTHERN CALIFORNIA ACADEMY OF SCIENCES.

Zoological Section.

Receipts.

John D. Hooker	\$150.00
City Council	500.00
Private, several members	23.50
	\$673.50

Disbursements.

Labor	\$502.11
Expense	37.45
	\$539.56

Balance on hand	\$133.94
Bills unpaid (approximate), labor, \$55.00."	

The Secretary was instructed to extend to Professor W. H. Housh, Principal of the High School, an expression of the appreciation of this Board for his kindness in furnishing room in the High School building for the work of cleaning the fossils lately excavated and giving them a secure place for storage.

Board adjourned.

At a meeting of the Directors on Friday, October 15, 1909, there were present Messrs. Bullard, Parsons, Watts, Collins, Keese and Spalding.

Mr. Fordyce Grinnell, Jr., of 572 Marengo Avenue, Pasadena, was elected to membership.

In view of the valuable acquisition of fossils from Rancho La Brea; the tender of geological and zoological collections; the necessity for the proper housing and care of these valuable contributions to science, and the increasing needs of the Academy, it was resolved to place before the members and the public generally, a formal statement of the financial requirements of the Academy, and solicit subscriptions, to enable us to continue a work which has been so fruitful of results.

A vote of thanks was unanimously given to Mr. John D. Hooker for an additional gift of \$500.00 for the prosecution of the excavations in Rancho La Brea.

Board adjourned.

The Geological Section was convened October 15, 1909, at the residence of Mr. S. J. Keese, No. 1509 Shatto Street.

Professor William L. Watts was elected Chairman and George W. Parsons was chosen Secretary for the year 1909-1910.

Mr. Parsons gave a most interesting account of the location of the springs, wells and water holes of the deserts in California, Nevada and Arizona, and the successful efforts made to induce the State and County authorities to erect signs throughout these arid wastes, which have resulted in the preservation of many lives by directing them to the nearest water supply.

Mr. L. W. Beck presented upon the screen many views of the desert, taken during his explorations, from Mono and Inyo Counties on the north, to San Diego on the south.

At the close of the meeting, Mr. Keese exhibited with his lantern some beautiful views of Lake Tahoe and vicinity.

NOVEMBER.

The regular meeting of the Academy was held on Monday evening, November 1, 1909, in Symphony Hall.

In the absence of the President and Vice-President, the assembly was called to order by the Secretary, and Professor Dozier was requested to preside.

The subject for discussion was "The Desert, its Geologic and Scenic Features, and Guide-Posts to Water."

Mr. George W. Parsons related events of his journeys across the gold-producing arid lands of Mono, Inyo, Kern and San Bernardino Counties and the southwestern portion of Nevada.

During the construction of the Salt Lake railroad, the remains of over thirty persons were found, and the shifting sands frequently uncover the bodies of those, whose empty water-cans told the story of their fatal wandering from a water supply. Numerous metal sign-posts have been erected throughout these deserts, with directions to the nearest water, and this life-saving work is being prosecuted as rapidly as funds become available by the State authorities and the supervisors of these Counties, who have become profoundly impressed by the representations of Mr. Parsons.

Professor William L. Watts gave a very graphic description of the geology, topography, mineral and botanical characteristics of these regions, and exhibited the necessity of these guide-posts for the saving of the lives of the numerous prospectors who, with reckless improvisance, roam over this desolate country in their mad search for gold.

Mr. L. West Beck, with his lantern, threw upon the screen views of this desert country, taken by him in his exploring trips from Mono to San Diego County.

At the close of the arranged program, Mr. Stanley McGinnis gave a short account of the discovery by Mr. George F. Clifton and himself, at Denver, Colorado, of the process of real color photography direct from nature, whereby the most delicate plants and the most picturesque landscape are shown through the negative, exactly as seen through the camera, illustrating his statement with a few views.

The proceedings of the evening were enlivened by music rendered by the High School Young Ladies' Quartet.

DECEMBER.

The announcement that the December meeting would be devoted to discussions of coelo locomotion, in view of the forthcoming aviation week in Los Angeles, resulted in a large attendance.

Mr. Charles F. Willard, of the Aeronautic Society of New York, who has made more than two hundred successful aeroplane flights, and who is to drive a Curtiss machine in the coming contests, gave a most interesting history of this new method of transportation.

The newly coined word "aviation," as distinguished from "aeronautics," refers to heavier-than-air dirigible machines driven by mechanical means. He related events in his experience, illustrating by views on the screen, the various parts of the aeronef, and its mode of ascent, operation and descent.

He was followed by Mr. George P. Harrison, Secretary of the California Aviation Society, who spoke upon aeronautics, or air-sailing, lighter-than-air machines.

He described the dirigibles of Roy Knabenshue and Count Zeppelin, and ballooning with the old type spherical bags.

The evening was one of intense interest to the Academy and its guests.

JANUARY.

The January, 1910, meeting of the Academy was devoted to the Geology and Quaternary Zoology of California.

Professor William L. Watts, in "An Outline of the Geological History of California," gave a most graphic account of the volcanic action and the tremendous erosions extending from Puget Sound to the southernmost point of Lower California, and the various uprisings and subsidence of this coast region from the Primary or Paleozoic, Devonian, Carboniferous and Permian times, down through its evolution during the Mesozoic, Triassic, Jurassic and Cretaceous period to the Eocene, Miocene and Pliocene of the Kainozoic, and ending with the quaternary times of the Pleistocene and alluvium deposits when the camel, the giant ground sloth and the sabre-tooth cat found a home in this land.

Professor James Z. Gilbert, from the platform laden with fossils excavated from the wonderful deposit in La Brea Rancho, in his discourse upon the Quaternary Life in California, related the characteristics of the now extinct fauna of two hundred thousand years ago.

The meeting resolved itself into a catechetical symposium with Professor Gilbert as the Socratic master, and his expositions of the various subjects propounded were received with marked attention and eminent satisfaction.

A meeting of the Directors was held in the office of the Secretary, on Saturday, January 8, 1910, at one o'clock p. m.

Professor James Z. Gilbert was present upon invitation.

The Secretary was instructed to inform the Trustees of the Field Museum of Natural History, in Chicago, Illinois, that owing to the conditions under which this Academy is pursuing the work of excavating at Rancho La Brea, it is impossible for us to accept any proposition for a participation with any foreign scientific body in the conduct of these investigations, and that its tender of assistance, dated November 11, 1909, must be declined.

Professor Gilbert gave a statement of the work now in progress at La Brea Rancho, and Mr. Spalding was appointed a committee to present the matter to the Board of County Supervisors and ask for an appropriation towards the expense of continued investigation.

The following named persons were elected members of the Academy, viz.: Elizabeth Yoder, Long Beach; Raymond D. Jewett, 1338 Cahuenga Street, Los Angeles.

Board adjourned.

The Directors held a meeting on January 31, 1910, at which the following gentlemen were elected members of the Academy, viz.: W. H. Wiley, W. L. Jepson, Samuel T. Tyson, Willard A. Nichols, Dr. Adolph J. Petter, Dr. Thomas Powell and Professor W. H. Housh. Mrs. Erskine M. Ross was elected an honorary member.

The President, Professor Watts, Professor Gilbert and Dr. Davidson were appointed a committee to consult with the County Supervisors in regard to the space desired by the Academy in the proposed County Museum Building to be erected in Agricultural Park.

Board adjourned.

FEBRUARY.

The regular February meeting of the Academy was held in Blanchard Hall on Saturday, the fifth.

Dr. David Starr Jordan, President of Stanford University, delivered a most interesting discourse upon the Samoan Islands and Robert Louis Stevenson, whose name as given by the natives was Tusitala, meaning the Story Teller, (Tusi, lengthwise or long; tala, talker). The flora and fauna of the Islands were illustrated by views thrown upon the screen, and in showing the wreck of the German war vessel now upon the coral reef, the story of the great hurricane was most graphically retold.

At the close of the remarks of Dr. Jordan, Professor Gilbert explained the nature of the excavations on La Brea Rancho, and exhibited to the audience many of the rare and curious fossils taken therefrom in his supervision of the work of this Academy.

NOTE: Vailema, the home of Stevenson, is a native word, from vai water, and lema, five; or the home of the five waters or springs.

The name given to Dr. Jordan by the natives is Talinoa i Faiva, (Talinoa obviously related to 'Tala, talker), or the teller of fish stories.

A meeting of the Directors was held on Saturday, February 19, 1910, at 2 o'clock p. m., in the office of the Secretary.

Present, Watts, Parsons, Keese, Davidson and Collins.

The Secretary reported that Mr. Spalding, as President, and himself as Secretary, on behalf of this Academy of Sciences, signed an agreement with the County of Los Angeles relating to the care, supervision, control and management of the Historical Museum and Art

Gallery, about to be erected at Agricultural Park by the County. Said agreement runs for fifty years, and provides that the said Historical Museum and Art Gallery shall be controlled and managed by a Board of Governors selected as follows, viz.:

- The Chariman of the Board of Supervisors;
 - Two persons to be selected by the Fine Arts League;
 - Two persons to be selected by the Historical Society;
 - Two persons to be selected by the Southern California Academy of Sciences;
 - One person to be selected by the Southern Division of the Cooper Ornithological Club;
 - One person at large selected by the parties hereinabove named.
- Said Governors shall hold office at the pleasure of the appointing power.

The action of the President and Secretary was approved, ratified and confirmed.

Professors Hector Alliot and J. H. Francis were elected members of the Academy.

The Secretary was requested to prepare a circular setting forth the objects and aims of this Academy, and cause the same to be distributed throughout Southern California.

Professor W. L. Jepson was appointed a delegate to represent this Academy at the Brussels Congress of Botanists, and the Secretary was instructed to transmit to Professor Jepson his credentials.

Dr. Davidson and President Spalding were unanimously elected Governors of the Historical Museum and Art Gallery.

The Los Angeles Chamber of Commerce was granted permission to print an extra edition of the January Bulletin of this Academy.

Board adjourned.

MARCH.

The regular meeting of the Academy for March was held in Symphony Hall on Monday, February 28, 1910, a large audience being present.

The speaker of the evening was Professor G. W. Ritchey, of the Mount Wilson Solar Observatory. His subject was "Celestial Photography with Refracting and Reflecting Telescopes."

He gave a most interesting description of refracting and reflecting telescopes, and the process of celestial photography, demonstrating the great advantages of the reflector over the refractor in this work. The types of refracting telescopes include the portrait lens or photographic-doublet; the standard photographic refractors with double tubes, used in making the "Casse du Ciel;" the great double refractors of Potsdam and Meudon; the 36-inch Lick refractor and its photographic corrector, and the 40-inch Yerkes refractor and its photographic attachment.

The reflecting telescopes described include the 24-inch Yerkes reflector; the 60-inch Mount Wilson reflector and the 100-inch Hooker reflector now in process of manufacture.

Sixty most beautiful photographs were thrown upon the screen illustrating the results secured by the various types of telescopes. These included views of the milky way, comets, star-clusters, nebulae, and the moon. Those taken with the great 60-inch reflector were most sharp in their definition and presented minute details of comets and the moon, and particulars regarding the nebulae heretofore unknown.

At the close of the lecture, a large portion of the audience remained and entered into an animated discussion with Professor Ritchey relating to his observations and the practical work in the manufacture of astronomical instruments.

A meeting of the Directors was held April 11, 1910, at which all were present except Davidson and Hooker.

Upon the representation of the Treasurer, it was resolved to propose to the meeting of the Academy in May, an amendment to Article X of the By-Laws, whereby members of the Academy residing without a radius of thirty miles from Los Angeles shall be charged only one dollar for annual dues, and the Secretary was instructed to prepare and propose the said amendment in behalf of the Directors.

Board adjourned.

APRIL.

The monthly meeting of the Academy was held in Symphony Hall on Monday evening, April 11, 1910.

The President exhibited the plans for the new County Historical Museum and Art Gallery, showing the wing to be placed at the disposition of this Academy, and explained the nature of the arrangement of fixtures and specimens.

Mr. William H. Knight introduced the regular subject of the evening by a statement of the supposed origin of comets.

The history of Halley's comet was presented by Mr. B. R. Baumgardt in his pleasant, graphic manner, and his discourse was illustrated by many interesting stereopticon views of comets, nebulae and other celestial objects.

MAY.

The annual meeting was held on May 2, 1910, in Symphony Hall, the President in the chair.

The annual report of the Secretary was read, and an amendment to the By-laws was proposed in writing, to the following effect:

Change the second paragraph of Article X, Dues, so that it shall read as follows, viz.:

"The Annual dues of active members shall be three dollars, which must be paid to the Treasurer in January.

"Provided: That the dues of members residing without a radius of thirty miles from the city of Los Angeles shall be but one dollar per year."

Under the provisions of Article XII of the By-Laws, the proposed amendment was ordered to lie over until the next regular meeting.

Dr. Anstruther Davidson gave a description of the quarters which this Academy will occupy in the Historical Museum and Art Gallery in Agricultural Park, and the Secretary described the situation and condition of the excavations at Rancho La Brea.

The following named gentlemen were unanimously elected Directors for the ensuing year, viz.:

Arthur B. Benton, Bernhard R. Baumgardt, Holdridge O. Collins, Anstruther Davidson, John D. Hooker, Samuel J. Keese, William H. Knight, George W. Parsons, Albert B. Ulrey, William L. Watts and William A. Spalding.

Dr. James A. Cronkhite, the speaker of the evening, gave a most entertaining description of the Yellowstone National Park, and his lecture was illustrated by numerous views colored after nature, accompanied with many moving pictures showing the tumbling waters of the rivers and falls, the geysers in action, the travels of tourists, and the bears, buffalo, elk and other wild animals in their native habitat.

Immediately after the adjournment of the annual meeting, the Directors for the ensuing year were called to order, and the following officers were elected, viz.:

William A. Spalding	President
Anstruther Davidson	First Vice-President
John D. Hooker	Second Vice-President
Samuel J. Keese	Treasurer
Holdridge O. Collins	Secretary

R. M. Bennett, of Minneapolis, Minn., was elected a life member, and Arthur L. Kelsey, Edward W. Coit, Mrs. James Sterling and Charles E. Warner, all of Los Angeles, were elected active members.

Board adjourned.

COMMITTEES FOR THE YEAR, 1910-1911.

On May 5th, President Spalding appointed the following committees for the year 1910-1911:

	Program.	
Watts,	Parsons,	Ulrey.
	Finance.	
Keese,	Baumgardt,	Benton
	Publication.	
Collins,	Davidson,	Hooker.

JUNE.

A meeting of the Directors was held on Monday, June 6, 1910. Present: Keese, Spalding, Parsons, Ulrey, Watts and Collins.

It was ordered that the time for holding the regular monthly meetings of the Academy shall be the first Friday, instead of the first Monday of the month, as heretofore.

Mr. Edwin C. Opperman, of 1806 Arlington Street, was employed to collect dues from members who are in arrears for two years or more, and to canvass the city for new members, his compensation to be fifty per centum of all amounts collected through his efforts.

Mr. Robert Le Roy Beardsley, of 2515 West Twenty-first Street, was elected a member of the Academy.

Professor P. Giovanni Hagen, S. J., Director of the Vatican Observatory at Rome, was elected an honorary member.

It was ordered that the appropriation of \$500.00 by the County Supervisors be devoted exclusively to the cleaning and mounting of the fossils from Rancho La Brea.

Board adjourned.

At a meeting of the Geological Section held on June 6, 1910, William L. Watts was elected Chairman and George W. Parsons Secretary.

The regular meeting of the Academy was held in Symphony Hall on June 6, 1910.

The President gave a general outline of the last year's work, and a description of the County Historical Museum and Art Gallery, now in process of construction at Agricultural Park, and the quarters therein which will be the home of this Academy.

Annual reports were presented by the Chairman of the Astronomical, Geological, Biological and Zoological Sections.

The amendment to Article X of the By-Laws, proposed at the May meeting was unanimously adopted.

The quartette of the Polytechnic High School, under the direction of Mrs. G. Parsons, rendered in a most exquisite manner the beautiful stanzas, which gave a world fame to the Oxford undergraduate Bourdillon:

“The night has a thousand eyes,
The day but one;
Yet the light of the whole world dies
With the dying sun.

“The mind has a thousand eyes,
And the heart but one;
Yet the light of a whole life dies
When love is gone.”

Later in the evening, Miss Helen Mack, the soprano of this quartette, with a solo, excited the astonishment of the audience, and an enthusiastic demand for a recall. The educated musical ear of those present recognized in this gifted young maid a voice of unusual power, sweetness and culture, a promise to her of future success, and of happiness to all who shall know her.

The young gentlemen composing the Glee Club of the Los Angeles High School, through the able training of their conductor, Miss V. Blythe, have arrived at a perfection of execution and culture of voice beyond that of mere amateurs, and the songs given by them were a surprise to all, and they were greeted with most hearty applause.

Short addresses were given by Professor J. H. Francis, Principal of the Polytechnic High School, and by Professor W. H. Housh, Principal of the High School.

The members closed the season's transactions with the gratifying knowledge that the work of the Academy during the past year had been the most successful since its organization.

HOLDRIDGE OZRO COLLINS,
Secretary.

A CORRECTION.

Professor James Z. Gilbert writes the Editor that, owing to a mistake in using the wrong proof sheet, the last paragraph on page 27 of the Bulletin for January, 1910, was unintentionally printed.

Statement of Condition of First National Bank

Los Angeles, California

At Close of Business, June 30, 1910

RESOURCES

Loans and Discounts	-	-	-	-	\$11,564,518.87
Bonds, Securities, Etc. (Bonds Only)	-	-	-	-	1,242,600.00
U. S. Bonds to Secure Circulation	-	-	-	-	1,250,000.00
Premium on U. S. Bonds	-	-	-	-	None
Cash and Sight Exchange	-	-	-	-	5,070,754.03
Total	-	-	-	-	\$19,127,872.90

LIABILITIES

Capital Stock	-	-	-	-	\$1,250,000.00
Surplus and Undivided Profits	-	-	-	-	1,768,980.45
Circulation	-	-	-	-	1,102,450.00
Reserved for Taxes	-	-	-	-	7,590.77
Deposits	-	-	-	-	14,998,851.68
Total	-	-	-	-	19,127,872.90

Statement of Condition of

Farmers & Merchants National Bank of Los Angeles

Los Angeles, California

At Close of Business July 7th, 1910

RESOURCES

Loans and Discounts	-	-	-	-	\$7,599,822.66
Bonds, Securities, etc.	-	-	-	-	3,598,771.47
Cash and Sight Exchange	-	-	-	-	4,960,427.37
					\$16,159,021.50

LIABILITIES

Capital Stock	-	-	-	-	\$1,500,000.00
Surplus and Undivided Profits	-	-	-	-	1,950,727.37
Circulation	-	-	-	-	1,499,997.50
Deposits	-	-	-	-	11,208,296.63
					\$16,159,021.50

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